DELAWARE RIVER BASIN, Pennsylvania

ARROWHEAD LAKE DAM

LEVEL II

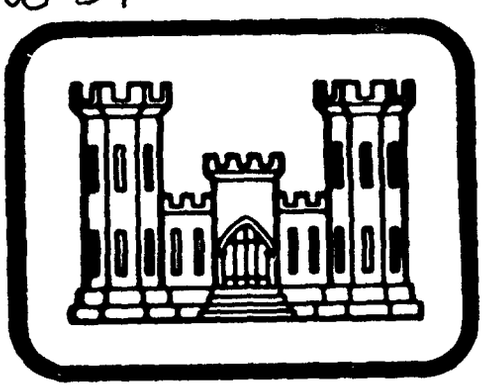
NDI NO. PA-00780

DER NO. 45-207

P.S.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-80-C-0019



PREPARED FOR
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

BY

Berger Associates, Inc.
Harrisburg, Pennsylvania

AUGUST 1980

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PREFACE

This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam:	ARROWHEAD LAKE DAM
State & State No.:	PENNSYLVANIA, 45-207
County:	MONROE
Stream:	TROUT CREEK
Date of Inspection:	May 6, 1980

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is intermediate and the hazard classification is significant. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. The recommended SDF for this dam is one-half the PMF. The spillway capacity is inadequate for passing the SDF peak inflow without overtopping the dam. When no failure occurs at the upstream dams, the project is capable of passing 43 percent of the PMF and is considered to be inadequate, but not seriously inadequate.

The following recommendations are made for immediate action by the owner:

1. That, to preclude the necessity of a detailed hydrologic and hydraulic study, the low areas in the embankment be filled and the crest be made uniform to the design crest elevation. This work should be performed under the direction of a professional engineer, experienced in the design and construction of dams.

2. That all brush and trees be removed from the embankment slopes and that a professional engineer, experienced in the design and construction of dams, be consulted for the removal of tree stumps and roots. The embankment shall be provided with an adequate vegetative cover.

3. That the downstream end of the blowoff pipe be uncovered and the pipe be made operable. This pipe should be modified to have an upstream control.

4. That the wet area downstream of the blowoff pipe be monitored on a regular basis noting and recording approximate volume and the clarity. If increase in volume or any turbidity is observed, immediate steps shall be taken to identify and correct the condition.

5. That the spillway discharge channel be cleared of derrick stone obstructions.

6. That voids under the end of the spillway slab be filled.

7. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

8. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: August 1, 1980

APPROVED BY:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
DATE 30 August 1980

OVERVIEW

LAKE ARROWHEAD DAM

Photograph No. 1

TABLE OF CONTENTS

(11) Aug 80

(12) 148

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(6)

ARROWHEAD LAKE DAM

Number (NDI-ID ~~NE~~ PA-00780,
DER-ID ~~NJ~~ 45-207)

Delaware River Basin, Phase I Inspection Report.

SECTION 1 - PROJECT INFORMATION

Monroe County, Pennsylvania.

(15) DACW31-80-C-0019

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: Project spillway crest elevation is 1657 (Appendix E, Plate III). The U.S.G.S. Quadrangle Sheet shows a reservoir elevation 1652.00. This U.S.G.S. elevation is used in this report as the top of spillway crest.

Arrowhead Lake Dam is an earthfill embankment with a cutoff trench and an impervious core. The maximum design height of the dam is about 18 feet above streambed. The dam has an overall length of about 450 feet. A 110 foot wide spillway is located near the right abutment. The concrete ogee weir has a crest elevation of 4.9 feet below the low point of the embankment and about 8 feet below the design crest elevation of the dam. There is a drop inlet structure near the center of the dam which is controlled with stoplogs. Removal of the stoplogs permits lowering of the pool level to about 9 feet below normal pool elevation. The drop inlet discharges through a 30-inch diamater pipe. Prior to construction of the stoplog structure, this pipe had a steel plate for closure at the upstream end. The dam was modified by the installation of a 24-inch outlet pipe on the right side of the spillway. This pipe has a gate valve at its downstream end.

411003 mt

Fill was placed along the downstream toe of the dam to provide for a parking area. This fill was placed across the outlet channel for the stoplog structure. The outlet pipe has been extended.

B. Location: Tobyhanna Township, Monroe County
U.S.G.S. Quadrangle - Thornhurst, Pa.
Latitude 41°-09.2', Longitude 75°-34.6'
Appendix E, Plates I & II

C. Size Classification: Intermediate: Height - 18 feet
Storage - 2344 acre-feet

D. Hazard Classification: Significant (Refer to Section 3.1.E.)

E. Ownership: Mr. Joseph J. Marone, Vice President
All-American Realty Co., Inc.
155 Willowbrook Boulevard
Wayne, NJ 07470

F. Purpose: Recreation

G. Design and Construction History

The dam was designed by C.E. Ferris of Hamlin, Pennsylvania, and constructed by the Robbins Door and Sash Company, Scranton, Pennsylvania. Construction was started in 1950 and was completed in 1954. Records of the construction do not exist. Over the years, modifications were made consisting of replacing the steel plate on the outlet pipe with a stoplog structure; the downstream extension of the outlet pipe under the parking lot; the placement of fill at the downstream toe; and the installation of a second outlet pipe at the right abutment.

H. Normal Operating Procedures

The reservoir is used for recreational purposes including swimming, boating and fishing. Cottages are located near the water's edge. Normal pool level (top of spillway weir) is desirable for recreational purposes. All inflow above the spillway level is discharged through the spillway.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	15.9
Computed for this report:	14.74
Use:	14.74

B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations

Maximum known flood, June 1972	435
Spillway capacity at pool Elev. 1656.9 (low point of dam)	4629
Stoplog structure capacity at Elev. 1656.9	84
Outlet works capacity at normal pool Elev. 1652	26

C. Elevation (feet above mean sea level)

Top of dam (low point)	1656.9
Top of dam (design)	1660
Spillway crest	1652
Bottom of stoplog structure	1643
Streambed at downstream toe (estimate)	1642

D. Reservoir (miles)

Length of normal pool (Elev. 1652.0)	1.1
Length of maximum pool (Elev. 1656.9)	1.2

E. Storage (acre-feet)

Spillway crest (Elev. 1652)	1077
Top of dam (Elev. 1656.9)	2344

F. Reservoir Surface (acres)

Top of dam (Elev. 1656.9)	364.6
Spillway crest (Elev. 1652)	217.6

G. Dam

Refer to Plate III in Appendix E for plan and section.

Type: Earthfill embankment with impervious core.

Length: 450 feet.

Height: 18 feet.

Top Width: 11 feet (surveyed).

Side Slopes: Design:
Upstream - 3H to 1V
Downstream - 2H to 1V

As surveyed:
Upstream - 3.3H to 1V (above water surface)
Downstream - 3.6H to 1V

Zoning: Impervious core.

Cutoff: Cutoff trench excavated four feet into impervious material, bottom width is ten feet.

Grouting: None.

H. Outlet Facilities

Stoplog Structure

Type: Drop inlet controlled by stoplogs.

Width of Stoplog Opening: 2.5 feet.

Location: Near center of dam.

Invert: 1643

Discharge Conduit: 30-inch CMP.

Blowoff Pipe

Type: Two foot diameter steel pipe through embankment.

Location: Near right abutment.

Control: Gate valve on downstream end.

Inlet Invert: 1648.0

Outlet Invert: 1647.0

I. Spillway

Type: Uncontrolled ogee weir.

Length of Weir: 110 feet.

Crest Elevation: 1652

J. Regulating Outlets

See Section 1.3.H. above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Hydrology and Hydraulics

Engineering data on the hydrologic and hydraulic design for these facilities were limited to statements in Report on the Application for Permit, and notes in the Pennsylvania Department of Environmental Resources (PennDER) files.

The spillway had a design capacity of 9600 cfs based on an eight foot depth, 110 foot length, and a "C" factor of 3.88. This capacity of 605 csm for a 15.9 sq.mi. drainage area exceeded the state's recommendation of 600 csm as the estimated maximum runoff.

B. Embankment and Appurtenant Structures

Design data for the embankment and appurtenant structures are not available. Construction drawings for the appurtenant structures and a typical section of the embankment are included in Appendix E.

2.2 CONSTRUCTION

Records of the construction of this dam are not available.

2.3 OPERATION

Records of operation have not been maintained. The reservoir has been drawn down on numerous occasions for removal of silt and shoreline debris.

2.4 EVALUATION

The only engineering data available for examination were contained in the files of PennDER, Division of Dam Safety. The data was limited to several drawings and a letter file.

A. Adequacy

While the available information contained in the files are limited, they are considered sufficient to make a reasonable assessment of the overall condition of the dam and its appurtenances.

B. Operating Records

Formal operating records have not been maintained for this dam.

C. Post Construction Changes

In 1966, a stoplog structure replaced the steel plate which was used for closure of the 30-inch diameter outlet pipe. This same pipe was extended downstream when fill was placed at the toe of the dam to create a parking area. In 1972, a second outlet pipe was installed adjacent to the right side of the spillway in the right abutment.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Arrowhead Lake Dam is fair. This structure is an earthfill embankment. One tree is located on the downstream side of the embankment near the center of the dam (Photograph No. 2, Appendix C).

The reservoir is used for recreation, including fishing, boating and swimming. The dam and reservoir are owned by All-American Realty Co., Inc., who developed a cottage resort area around the lake and dam.

The visual inspection check list is in Appendix A of this report. This appendix also has several sketches made from survey information obtained by the inspection team. Included are a general plan, profile, typical section and several details. Photographs taken during the inspection are reproduced in Appendix C.

B. Embankment

The embankment is relatively short, about 250 feet to the left of the spillway and about 75 feet at the right side of the spillway. The embankment slopes are covered with grass with bare spots in places where heavy foot traffic occurs. The upstream slope has riprap at the water's edge over about three-quarters of its length. The remaining portion near the left abutment adjoins a swimming area where the embankment slope is relatively flat and is partially covered with sand. A boat launching area is located on the embankment near the center of the dam. This area has been worn bare. The top of the embankment is about 11 feet wide and has been worn bare by vehicular traffic. The downstream slope is fully protected by grass. One large tree is growing on the embankment. The area at the toe has been filled for use as a parking lot. This fill appears to be higher than the normal pool level, and no seepage could be detected. At the right side of the spillway the embankment is fully grass covered, except for several footpaths. Brush is growing along the right spillway wall. This area is the lowest part of the embankment and was excavated in 1972 for installation of a 24-inch pipe. Wet spots were noticed in the outlet swale downstream from this blowoff pipe.

C. Appurtenant Structures

The spillway is a 110 foot wide concrete ogee weir. A short concrete apron is downstream of the ogee section. Concrete walls abut

both sides of the ogee section and apron. All concrete is in good condition. The right spillway wall is one foot lower than the design elevation. There is a wide construction joint between the ogee section and the apron. A 2.5 foot drop-off is located at the downstream end of the apron. Cavitation has occurred at the end of the apron slab. The downstream channel has several large boulders along the banks just downstream of the apron. One of these has rolled into the channel (Photograph No. 6).

A stoplog structure is located near the center of the dam at the upstream toe of the embankment. The concrete is in fair condition. A wire fish screen is located on top of the stoplogs. This screen tends to accumulate debris. The outlet pipe from this structure terminates at the natural stream channel in an area that is heavily overgrown.

A two foot blowoff pipe is located to the right side of the spillway. This pipe has a gate valve at the downstream end. The top of the valve casing was the only part visible during the inspection. The outlet was buried and could not be inspected.

D. Reservoir Area

The reservoir area has flat banks which appear to be stable. The area is mostly wooded with cottages, homes and a swim beach near the water's edge. The reservoir has been drawn down several times to clear debris from the shoreline and remove silt on beaches.

E. Downstream Channel

The downstream channel is a typical mountain stream with tree lined overbanks. A maintenance building is located immediately downstream from the dam. About 1000 feet downstream there is a road crossing. The hazard category for this dam is considered to be "Significant."

3.2 EVALUATION

The visual inspection indicates that these facilities are in fair condition. Trees and brush on the embankment should be removed. Although seepage is occurring in the vicinity of the blowoff pipe, there is no serious concern as long as no fines are noticeable in the seepage water. This condition should, however, be monitored on a regular basis noting any change in volume of flow or clarity of the water. The area around the downstream end of the blowoff pipe should be cleared.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The operational procedures for Arrowhead Lake Dam are limited. The reservoir is used for recreation. Keeping the pool level at spillway weir elevation is the major concern. All inflow above that level is discharged over the spillway and the stoplogs.

4.2 MAINTENANCE OF DAM

The visual inspection of this dam indicates that the facility is maintained in good operating condition with the exception of the small trees along the right spillway wall and one large tree near the center of the dam on the downstream slope. The embankment is free of heavy brush except near the right spillway wall. The embankment is apparently below its design crest elevation.

4.3 MAINTENANCE OF OPERATING FACILITIES

The stoplog structure is in fair condition. The overall condition of the spillway is good. The blowoff pipe at the right side of the spillway is not operable. The outlet for this pipe is buried.

4.4 WARNING SYSTEM

Although daily observations are made, there is no formal surveillance plan or downstream warning system.

4.5 EVALUATION

The operational procedures should be expanded and should include the removal of trees and brush on the embankment. The bare areas should be seeded to provide a dense protective grass mat. The spillway should be inspected annually and any necessary repair work should be performed. The outlet end of the blowoff pipe should be uncovered and the valve inspected regularly and repaired when needed.

A formal surveillance plan and downstream warning system should be developed for implementation during high or prolonged precipitation.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analyses available from PennDER for Arrowhead Lake Dam were not very extensive. No stage-discharge curve, stage-storage curve, unit hydrograph, or flood routings were contained in the PennDER files.

B. Experience Data

The greatest known flood at Arrowhead Lake Dam occurred in June, 1972, when the water level in the reservoir reached an elevation about one foot above the spillway crest. This storm was passed without difficulty.

C. Visual Observations

During the inspection, it was noted that the blowoff pipe was not operable. The fish screen at the stoplog structure tends to accumulate debris. No other conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event until the pool level would reach an elevation higher than the low point near the right abutment. There are three dams located upstream of Arrowhead Lake. These have been considered in the hydrologic analysis (Appendix D).

D. Overtopping Potential

Arrowhead Lake Dam has a total storage capacity of 2344 acre-feet at its present low point elevation and an overall height of 18 feet. These dimensions indicate a size classification of "Intermediate"; the hazard classification is "Significant" (See Section 3.1.E.).

The Spillway Design Flood (SDF) for a dam having the above classification is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. Based on the limited possibility of loss of life of transient people only, the recommended SDF for this dam is one-half the PMF. The SDF peak inflow is 6265 cfs (See Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 6265 cfs with the estimated spillway discharge capacity of 4713 cfs, based on the low point elevation on the crest, indicates that a potential for overtopping of the Arrowhead Lake Dam exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam does not have the necessary storage available to pass the PMF without overtopping. The spillway-reservoir system can pass a flood event equal to 43% of a PMF without failure of any of the upstream dams.

E. Dam Break Evaluation

Although Arrowhead Lake Dam does not overtop until the magnitude of a flood event exceeds 43% of a PMF, an upstream dam at Brady Lake overtops with considerably less discharge. It was noted that the upstream dam has an earth embankment and is expected to attain water levels that would result in a breach when flood events of less magnitude than 43% of a PMF occurred. For this reason, it was assumed that the upstream dam would fail when the water level reached an elevation that would result in a breach. Being an earth embankment, it is judged that the breach would be completed within a 15 minute through two hour time interval. For this analysis, the most conservative condition, the 15 minute breach, was considered.

F. Spillway Adequacy

The intermediate size category and significant hazard category, in accordance with the Corps of Engineers' criteria and guidelines, indicates that the SDF for this dam should be in the range of one-half the PMF to the full PMF. For this dam the recommended SDF is one-half the PMF.

Calculations show that the combined spillway discharge capacity and reservoir storage capacity are capable of handling 43% of the PMF when the upstream Bradys Dam remains intact. When the upstream dam fails, Arrowhead Lake Dam has sufficient spillway discharge capacity and reservoir storage capacity to handle 18% of a PMF. If the top of Arrowhead Lake Dam would be made uniform at the design elevation, the project would be capable of passing 83% of a PMF without overtopping, and without breach of the upstream dam.

Since the combined spillway discharge and reservoir storage capacity cannot pass the PMF, and since the hazard category is significant, the spillway capacity is judged to be inadequate but not seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

The visual inspection of Arrowhead Lake Dam did not find any major signs of distress which would signify an unstable structural condition. The embankment is grass covered with the exception of a few bare spots where heavy foot traffic occurs. There are several small trees growing adjacent to the right spillway wall and one large tree on the downstream slope near the center of the dam. The only riprap visible was along the waterline. Fill was placed at the downstream toe to create a parking lot. This area has been raised above the normal pool level.

A low spot in the embankment is located to the right of the spillway. A wet area was noticed at the downstream toe of this portion of the embankment.

2. Appurtenant Structures

The appurtenant structures for this dam include the spillway, the stoplog structure and the outlet pipes.

The spillway is a concrete ogee type weir. There was no evidence of displacement of the weir. The apron downstream of the weir consists of concrete slabs. The construction joint between the ogee section and the apron is about one-half inch wide. Some cavitation has occurred below the downstream end of the slab. The concrete is in good condition.

The stoplog structure is in fair condition. No cracks appear above water level. Some deterioration was noticed in the bottom of the drop inlet. The access ladder was not secured. The outlet from this structure is a 30-inch CMP pipe. The downstream end of this pipe is partially obstructed by debris and trees.

The two foot diameter blowoff pipe is located at the right side of the spillway. The only portion of this pipe that is visible is the top of the valve casing. The outlet to this pipe is burried. The blowoff is inoperable.

B. Design and Construction

Design and construction data are limited to design drawings and some letters. A cutoff trench was excavated to a depth of four feet

into an impervious hardpan strata. The trench has a bottom width of ten feet. The center section of the embankment and the backfill in the trench consists of an impervious material. More pervious material was used in the outer shell. The existing slopes appear to be adequate for this dam.

The outlet pipe has two cutoff collars upstream from the trench. The concrete ogee section has an exposed height of about 3.5 feet and a base width of nearly seven feet. The downstream slab has been concreted and has a cutoff wall. The spillway walls are gravity type sections with a base width of 0.54 times the height. Anti-seepage fins were placed behind the walls. The drawing indicates an adequate design.

C. Operating Records

There are no formal operating records for this dam.

D. Post Construction Changes

Several changes have taken place since construction was completed in 1954. About 1966, repairs were made to the concrete ogee weir, the spillway walls and the apron slab. At about the same time, the drop inlet structure was altered and the stoplogs were installed. In 1970 the right embankment was restored. In 1972 the two foot blowoff pipe was installed in this area. Over the years fill has been placed at the downstream toe to create a parking lot. This fill reaches a level above the normal pool level.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection and the review of available information indicate that the dam and its appurtenant structures are in fair condition. The trees and brush on the embankment should be removed. Seepage exists near the downstream end of the blowoff. The water is clear at the present time. Close observation and monitoring of this condition is recommended.

In accordance with the Corps of Engineers' evaluation guidelines, the spillway is inadequate for passing the full PMF peak inflow without overtopping the dam. The combination of the storage and spillway capacity is sufficient for passing only 43 percent of the PMF; and although the spillway is inadequate, it is not considered to be seriously inadequate.

B. Adequacy of Information

Although the available engineering data are not sufficient to make a detailed analysis of the stability of the dam and its appurtenant structures, the available drawings, reports and the observed physical conditions are judged to be adequate for making a reasonable assessment of the overall condition of the dam.

C. Urgency

The recommendations presented below should be implemented immediately.

D. Necessity for Additional Studies

Additional studies are not required at this time if the low areas in the crest of the dam are filled to design elevation.

7.2 RECOMMENDATIONS

In order to assure the safe operation of this dam, the following recommendations are presented for implementation by the owner:

1. That, to preclude the necessity of a detailed hydrologic and hydraulic study, the low areas in the embankment be filled and the crest be made uniform to the design crest elevation. This work should be performed under the direction of a professional engineer, experienced in the design and construction of dams.

2. That all brush and trees be removed from the embankment slopes and that a professional engineer, experienced in the design and construction of dams, be consulted for the removal of tree stumps and roots.

3. That the downstream end of the blowoff pipe be uncovered and the pipe be made operable. This pipe should be modified to have an upstream control.

4. That the wet area downstream of the blowoff pipe be monitored on a regular basis. If an increase in volume or any turbidity is observed, immediate steps shall be taken to identify and correct the condition.

5. That the spillway discharge channel be cleared of large derrick stone obstructions.

6. That voids under the end of the spillway slab be filled.

7. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

8. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

APPENDIX A

CHECKLIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 45-207 NDI NO. PA-00 780

NAME OF DAM ARROWHEAD LAKE DAM HAZARD CATEGORY Significant

TYPE OF DAM Earthfill

LOCATION Tobyhanna TOWNSHIP Monroe COUNTY, PENNSYLVANIA

INSPECTION DATE 5/6/80 WEATHER Sunny-Warm TEMPERATURE 70's

INSPECTORS:	OWNER'S REPRESENTATIVE(s):
R. Houseal (Recorder)	
H. Jongsma	Charles Roy
R. Shireman	Del Bachman
A. Bartlett	

NORMAL POOL ELEVATION: 1652.0 (U.S.G.S.) AT TIME OF INSPECTION:

BREAST ELEVATION: 1660.0 (Design) POOL ELEVATION: 1657.0

SPILLWAY ELEVATION: 1652.0 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: Est. 1.653.0 - 1972 (Agnes)

GENERAL COMMENTS:

Slide gate replaced with wet well in about 1965.

The general appearance of this facility is fair. It is used for recreation by the surrounding private residential development.

C.E. Ferris - Designer.

NDI NO. PA-00 780

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None observed.
B. UNUSUAL MOVEMENT BEYOND TOE	None observed.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None observed. Downstream slope (left side) is uneven at tree [(18") only one].
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Slightly curved. For vertical profile see Plate A-II. Note low profile in area at right end of embankment.
E. RIPRAP FAILURES	No exposed riprap on slope. Riprap is covered with soil and grass.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Abutments are sound. Embankment 9"-12" below top of wall on left side. Some erosion adjacent to spillway wall on left side - both upstream and downstream.
G. SEEPAGE	None on left side. Pipe on right side. Either buried valve leaking or seepage along pipe.
H. DRAINS	None.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Mowed lawn on both slopes and crest. Some bare spots on crest.

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Concrete wet well drop structure. Open on top. Ladder of reinforcing steel for access to bottom. Ladder is not fixed. Unsafe for one person. Large rocks laying in bottom of well. Concrete in fair condition - no cracks above water level. Deterioration below water surface. Screen is blocking inflow below water surface.
B. OUTLET STRUCTURE	Outlet pipe CMP at existing end. This is an extension of originally installed pipe to accomodate the parking area. No endwall. Partially overgrown.
C. OUTLET CHANNEL	Natural stream. Outlet channel swale to creek is wet and soggy. No flow. Seepage probably from the area around unknown pipe.
D. GATES	Stoplog control at wet well - left of spillway. Valve of unknown size blowoff pipe on right side of spillway. Inoperable.
E. EMERGENCY GATE	Same as D. above.
F. OPERATION & CONTROL	Occasional use of stoplogs to maintain minimum flow in stream.
G. BRIDGE (ACCESS)	No bridge. Access directly from upstream slope at water's edge. Boat required if pool is high.

NDI NO. PA-00 780

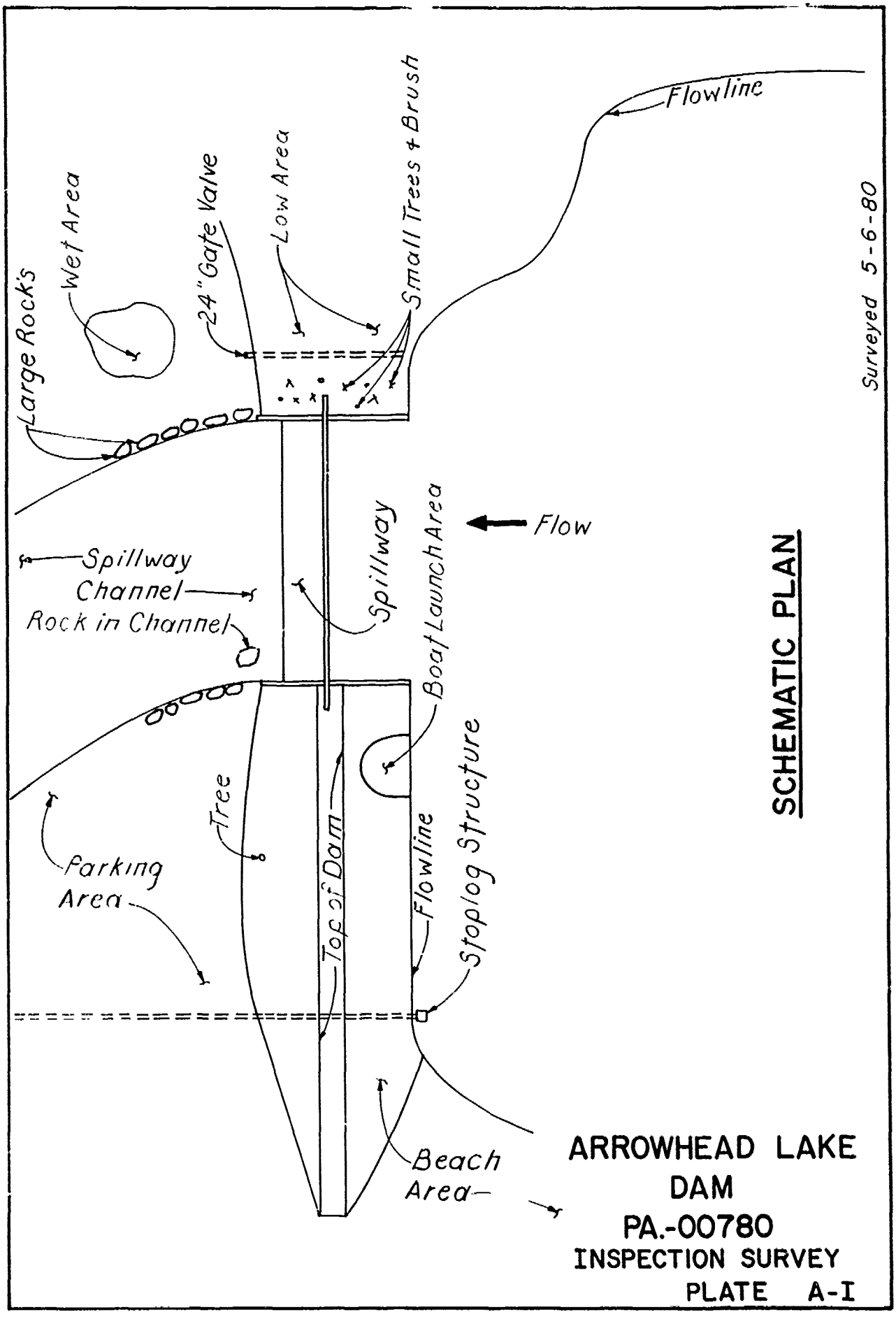
VISUAL INSPECTION
SPILLWAY

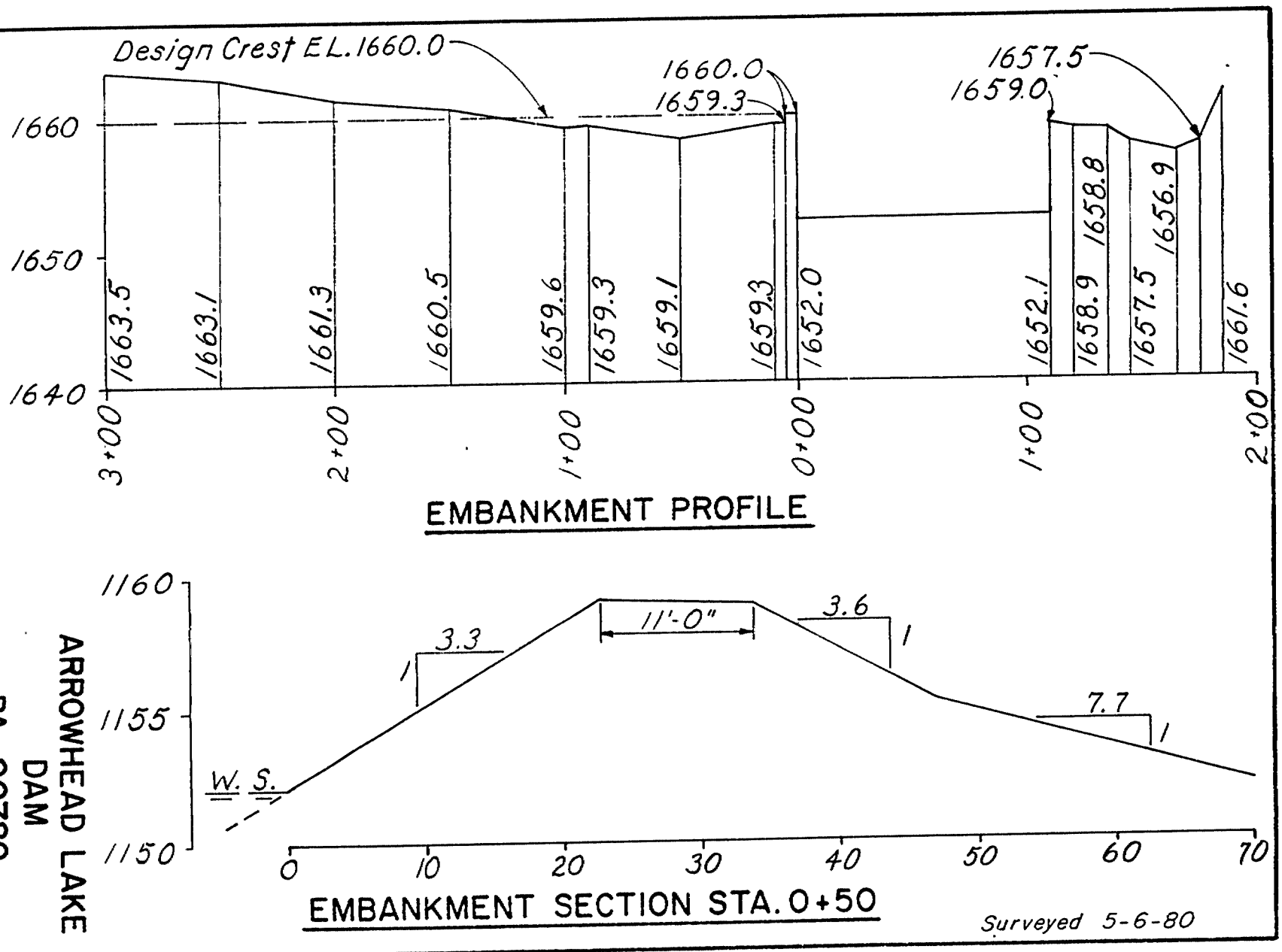
	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Directly from reservoir - unobstructed.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Small concrete ogee with run-out slab. Concrete all in good condition. Minor deterioration. Open joint between slab and ogee section.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Concrete slab to about 30'± downstream from toe of ogee. Concrete wing walls. Discharge channel below concrete structure is the natural stream. Rock bottom. End of slab shows cavitation under slab over most of its length up to 8 inches deep. Large boulders on both sides of channel at end of wing walls. One big boulder at end should be removed. Some rrap protection to be placed at end of wing.
D. BRIDGE & PIERS	None.
E. GATES & OPERATION EQUIPMENT	None - uncontrolled.
F. CONTROL & HISTORY	None - maximum flow estimated at about one foot over weir in June 1972 (Agnes).

NDI NO. PA-00 780

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR Slopes	Relatively level - homes and cottages surround the lake.
Sedimentation	None reported.
Watershed Description	Flat slopes - wooded.
DOWNSTREAM CHANNEL Condition	Mountain stream - stony bottom - wooded over banks.
Slopes	Moderate.
Approximate Population	2
No. Homes	Storage garage just below dam.


Flowline
Surveyed 5-6-80
Small Trees + Brush
Low Area
24" Gate Valve
Wet Area
Large Rock's
Flow
Spillway
Spillway Channel
Rock in Channel
Boat Launch Area
Tree
Top of Dam
Flowline
Stoplog Structure
Parking Area
Beach Area
SCHEMATIC PLAN
ARROWHEAD LAKE
DAM
PA.-00780
INSPECTION SURVEY
PLATE A-I


Design Crest EL. 1660.0
1660.0
1659.3
1657.5
1659.0
1660
1650
1640
1663.5
1663.1
1661.3
1660.5
1659.6
1659.3
1659.1
1659.3
1652.0
1652.1
1658.9
1658.8
1657.5
1656.9
1661.6
3+00
2+00
1+00
0+00
1+00
2+00
EMBANKMENT PROFILE
1160
1155
1150
W. S.
3.3
1
11'-0"
3.6
1
7.7
1
0
10
20
30
40
50
60
70
EMBANKMENT SECTION STA. 0+50
Surveyed 5-6-80
ARROWHEAD LAKE DAM
PA.-00780
INSPECTION SURVEY
PLATE A-II

APPENDIX B

CHECKLIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 45-207 NDI. NO. PA-00 780

NAME OF DAM ARROWHEAD LAKE DAM

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Thornhurst See Plate II, Appendix E
CONSTRUCTION HISTORY	Construction started in 1950. Completed in 1954.
GENERAL PLAN OF DAM	Plate III, Appendix E.
TYPICAL SECTIONS OF DAM	Plate III, Appendix E.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	Plans in PennDER files. See also plans in Appendix E.

NDI NO. PA-00 780

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	No records.
GEOLOGY REPORTS	Not located.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None, except some calculations by PennDER to check spillway capacity. None. None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	None. Test pits.
POST CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Spillway repaired and drop inlet structure modified to become stoplog structure about 1966. Portion of embankment raised in 1970. Blowoff pipe installed in 1972.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	None.
SPILLWAY PLAN, SECTIONS AND DETAILS	Plate III, Appendix E.

NDI NO. PA-00 780

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Stoplog structure. 24" diameter gate valve on blowoff pipe.
CONSTRUCTION RECORDS	None.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	Inspection called for spillway repairs in 1965. Inspected when repaired in 1970.
MISCELLANEOUS	

NDI NO. PA-00 780

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mostly woodland

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 1652 Acre-Feet 1077

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 1656.9 Acre-Feet 2344

MAXIMUM DESIGN POOL: Elev. 1660

TOP DAM: Elev. 1656.9

SPILLWAY:		DROP INLET
a. Elevation	1652	1652
b. Type	ogee weir	stoplog structure
c. Width	110'	2.5'
d. Length	---	---
e. Location Spillover	right abutment	center of dam upstream toe
f. Number and Type of Gates	none	none

OUTLET WORKS:

a. Type 24" diameter pipe with gate valve

b. Location at right side of spillway

c. Entrance inverts 1648

d. Exit inverts 1647

e. Emergency drawdown facilities 24" diameter pipe with gate valve

HYDROMETEOROLOGICAL GAGES:

a. Type none

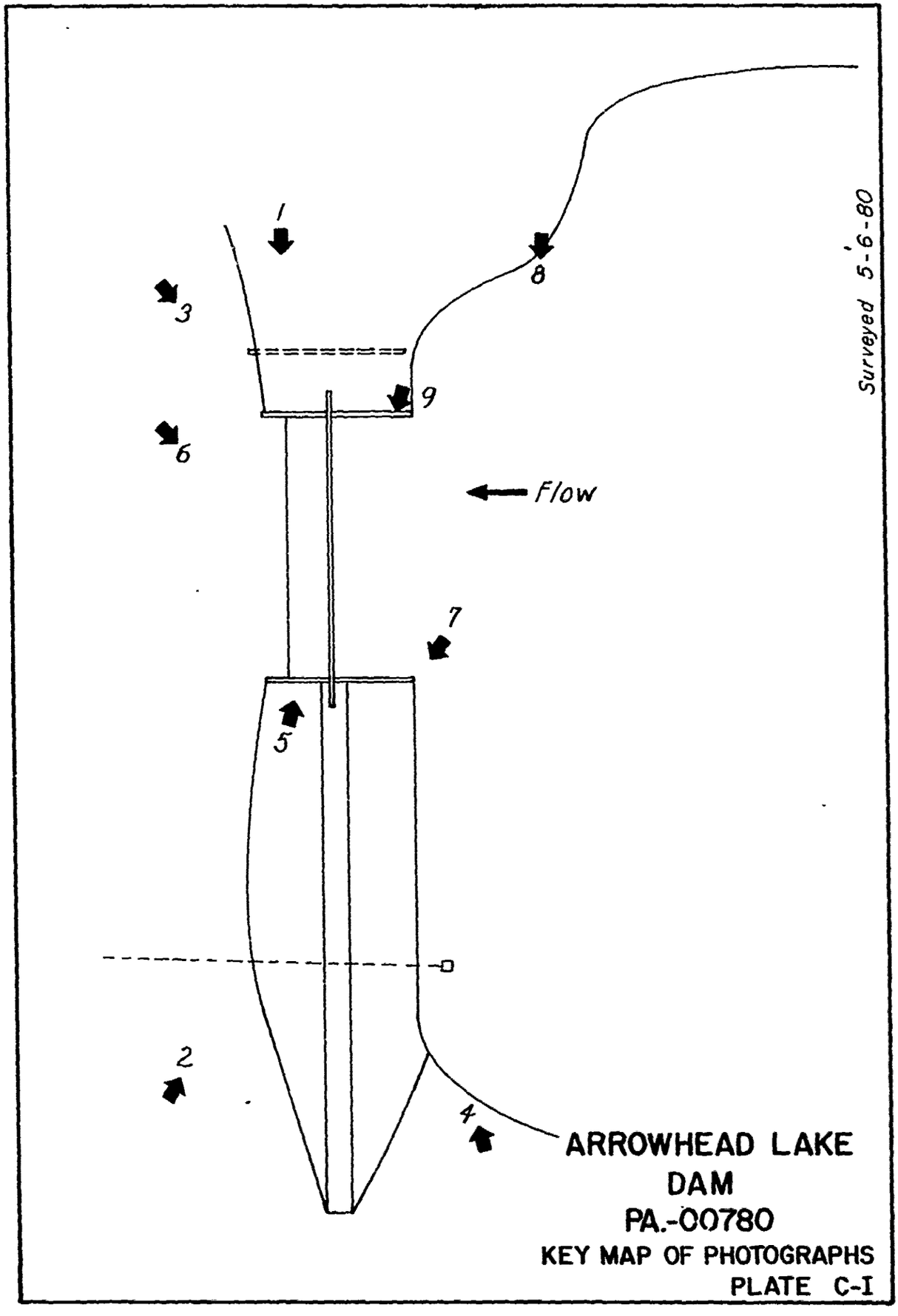
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 4629 cfs

APPENDIX C

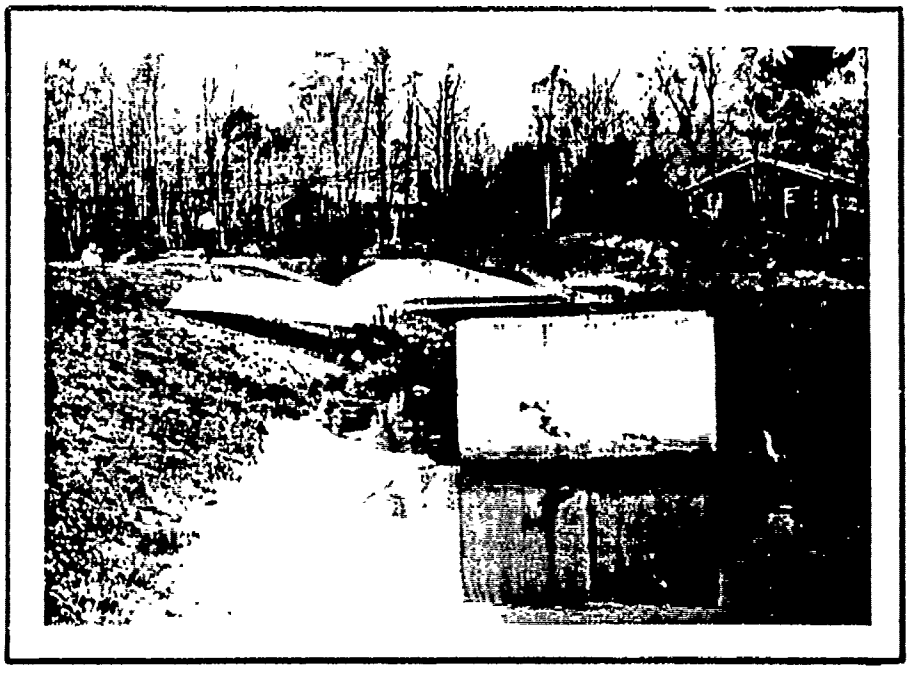
PHOTOGRAPHS



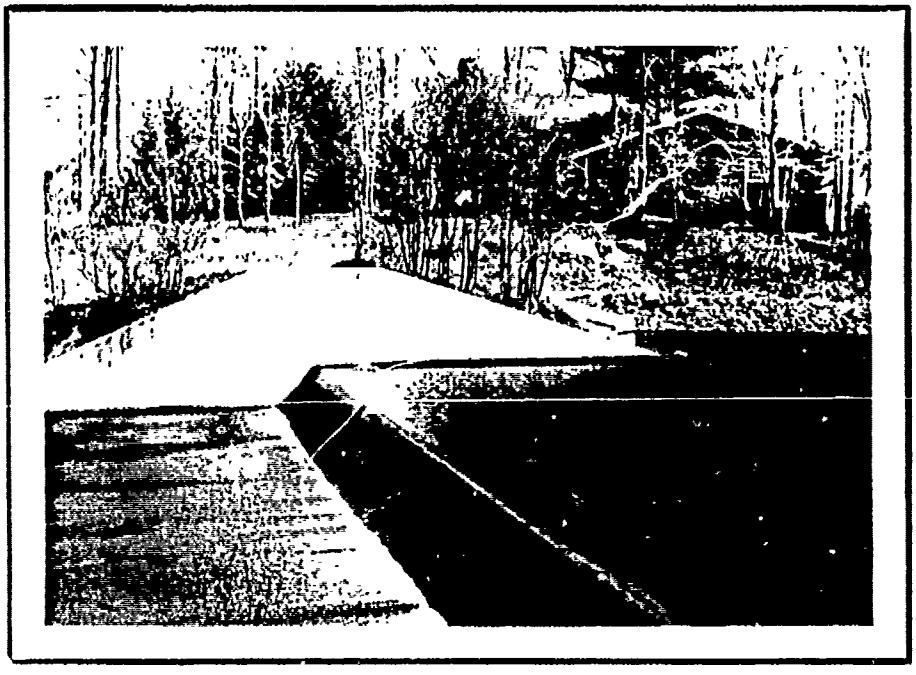
ARROWHEAD LAKE
DAM
PA.-00780
KEY MAP OF PHOTOGRAPHS
PLATE C-I

DOWNSTREAM SLOPE LEFT ABUTMENT - NO. 2

LOW AREA RIGHT OF SPILLWAY - NO. 3
NOTE VALVE IN FOREGROUND

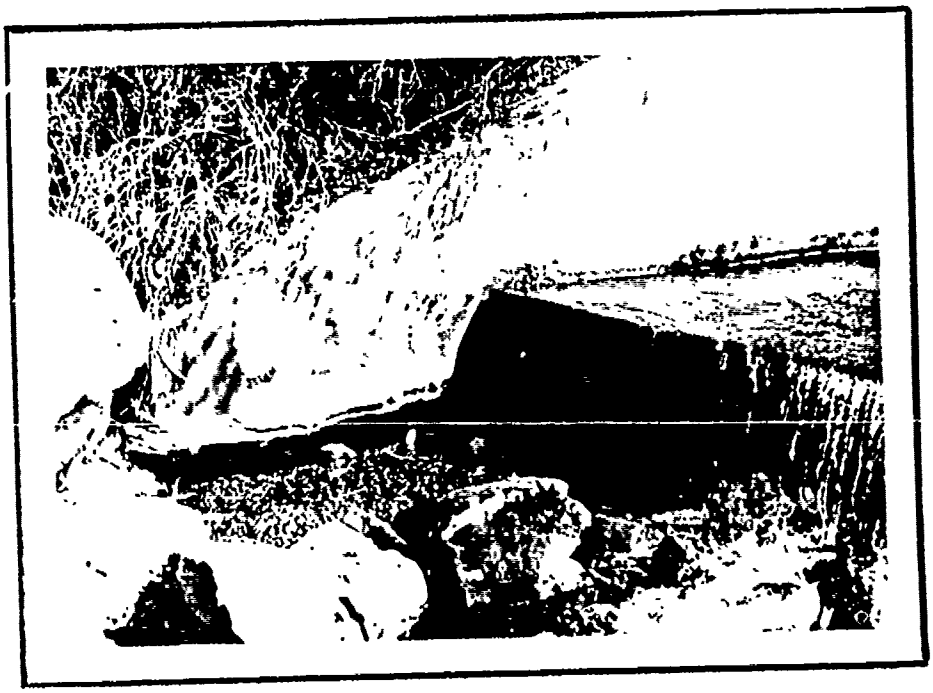


UPSTREAM SLOPE AND STOPLOG STRUCTURE - NO. 4



SPILLWAY - NOTE TREES FARSIDE - NO. 5

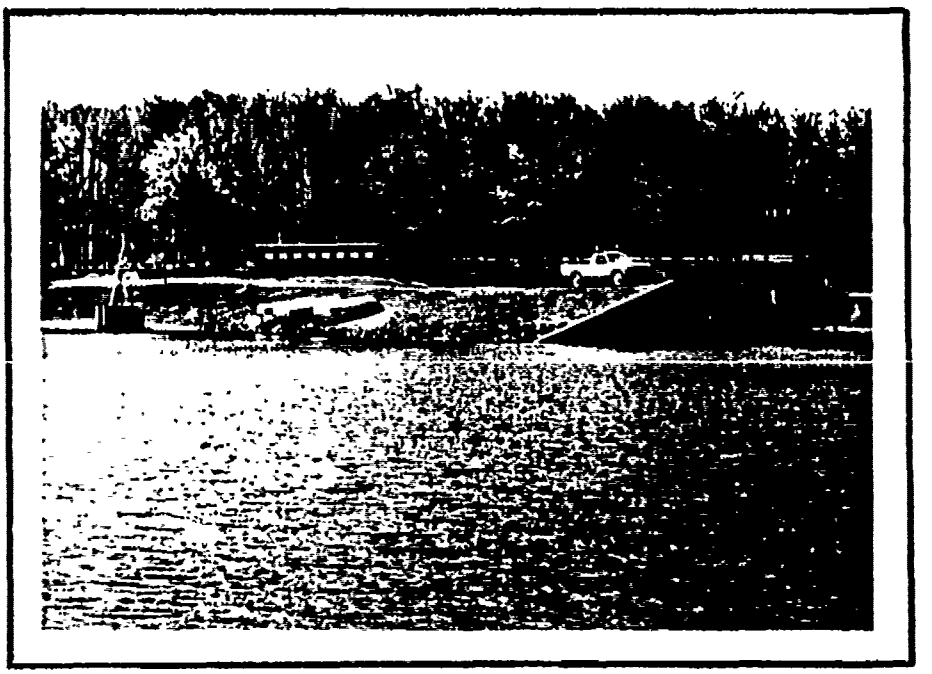
SPILLWAY LOOKING UPSTREAM - NO. 6



RIGHT SPILLWAY WINGWALL - NO. 7

PA-00780
Plate C-IV

FOREBAY OF SPILLWAY - NO. 8
NOTE MAINTENANCE BUILDING



OVERVIEW OF UPSTREAM SLOPE - NO. 9

PA-00780
Plate C-V

APPENDIX D

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

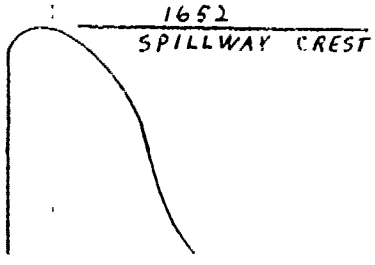
The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

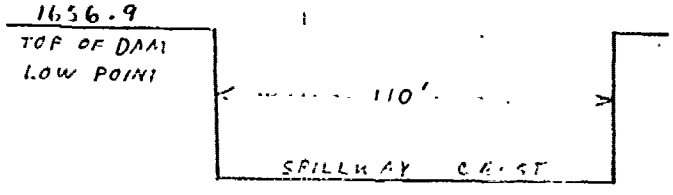
For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

BY RLS DATE 5/20/80 **BERGER ASSOCIATES** SHEET NO. 1 OF
CHKD. BY DATE PROJECT 0965?
SUBJECT ARROWHEAD LAKE

SPILLWAY RATING



OGEE
SECTION C = 3.88 (SMALL DAMS)



$Q = C L H^{3/2}$

$H = 1656.9 - 1652 = 4.9'$

$Q = 3.88 \times 110 \times (4.9)^{1.5}$

$= 1629$ cfs

BY RLS DATE 5/20/80 **BERGER ASSOCIATES** SHEET NO. 2 OF
CHKD. BY DATE PROJECT D9650
SUBJECT ARROWHEAD LAKE

DISCHARGE THROUGH OUTLET WORKS

STOP LOG STRUCTURAL WITH FISH SCREEN

OUTLET PIPE 2.5' DIA

INVERT 1643'

$Q = CA\sqrt{2gH}$ $C = 0.6$

AT POOL ELEV 1656.9

$H = 1656.9 - 1644.25 = 12.65'$

$Q = 0.6 \times \pi \times \frac{(2.5)^2}{4} \times (2 \times 32.2 \times 12.65)^{0.5}$

$= 64$ CFS

LOW FLOW (ONE FOOT) OVER STOP LOGS

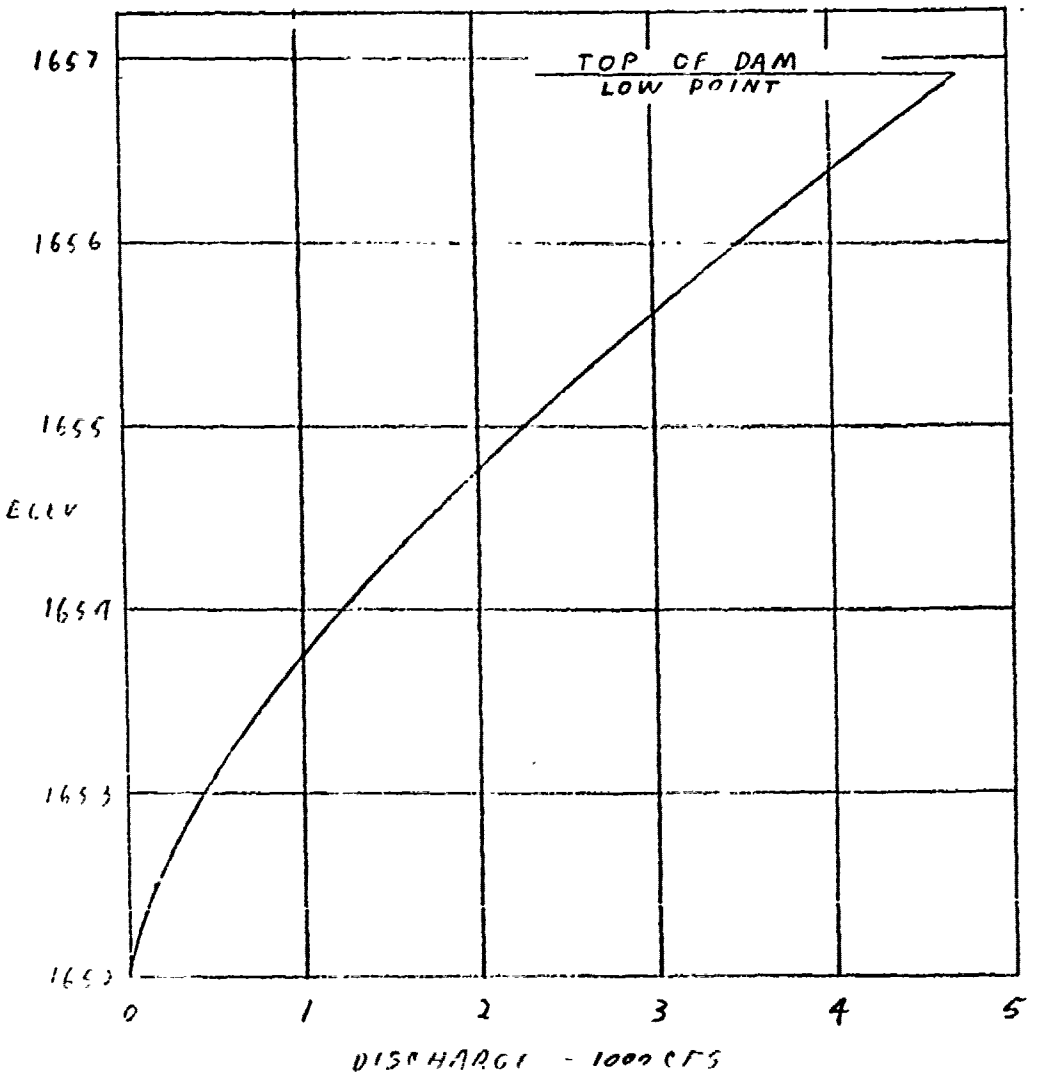
$Q = CLH^{3/2}$ $C = 3.3$ (KINGS HDBK)
$L = 2.5'$

$Q = 3.3 \times 2.5 \times (1)^{3/2}$

$= 8.2$ CFS

BY RLS DATE 5/20/80 **BERGER ASSOCIATES** SHEET NO. 3 OF
CHKD. BY DATE PROJECT D 96
SUBJECT ARROWHEAD LAKE

COMBINED SPILLWAY AND STOP LOG STRUCTURE RATING CURVE



BY FLS DATE 5/22/80 | BERGER ASSOCIATES | SHEET NO. 4 OF
CHKD. BY DATE | PROJECT D965.1
SUBJECT ARROWHEAD LAKE

DISCHARGE THRU OUTLET WORKS

2' DIA. STEEL PIPE WITH GATE VALVE

INVERT ELEVATION = 1648

$Q = CA\sqrt{2gH}$ $C = 0.6$

AT NORMAL POOL ELEV 1652

$H = 1652 - 1649 = 3'$

$Q = 0.6 \times \pi \times (2)^2/4 \times (2 \times 32.2 \times 3)^{0.5}$

$= 26$ CFS

AT LOW POOL ELEV 1650

$H = 1650 - 1649 = 1'$

$Q = 0.6 \times \pi \times (2)^2/4 \times (2 \times 32.2 \times 1)^{0.5}$

$= 15$ CFS

MAXIMUM KNOWN FLOOD AT DAMSITE

THE MAXIMUM KNOWN FLOOD AT ARROWHEAD LAKE DAM OCCURRED IN JUNE 1972 WHEN THE WATER LEVEL IN THE LAKE REACHED AN ELEVATION ABOUT 1.0' ABOVE THE SPILLWAY CREST

SPILLWAY	OUTLET WORKS
$C = 3.88$	$C_2 = 3.3$
$L = 110'$	$L_2 = 2.5'$
$H = 1.0'$	$H_2 = 1.0'$

$$Q = C L H^{3/2} + C_2 L_2 H_2^{3/2}$$

$$3.88 \times 110 \times (1.0)^{1.5} + 3.3 \times 2.5 \times (1.0)^{1.5}$$

$$= 435 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 2344 ACRE FEET
MAXIMUM HEIGHT = 18 FEET
SIZE CLASSIFICATION IS "INTERMEDIATE"

HAZARD CLASSIFICATION

A MAINTENANCE BUILDING IS LOCATED IMMEDIATELY DOWNSTREAM OF THE DAM.
USE "SIGNIFICANT"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDI EQUAL TO ONE-HALF PMF TO THE PROBABLE MAXIMUM FLOOD.

BY RLS DATE 5/20/80 **BERGER ASSOCIATES** SHEET NO. 6 OF
CHKD. BY DATE PROJECT D965
SUBJECT ARROWHEAD LAKE

EMBANKMENT RATING

$Q = C L H^{3/2}$ $C = 2.7$ (KINGS HDBK.)

AT ELEV. 1657.5

$2.7 \times 25 \times (.3)^{1.5} = 11$ CFS

AT ELEV 1658

$2.7 \times 25 \times (.8)^{1.5} = 48$

$2.7 \times 5 \times (.25)^{1.5} = 2$

$2.7 \times 1 \times (.25)^{1.5} = -$ $\Sigma = 50$ CFS

AT ELEV 1658.5

$2.7 \times 25 \times (1.3)^{1.5} = 100$

$2.7 \times 11 \times (.5)^{1.5} = 11$

$2.7 \times 3 \times (.5)^{1.5} = 3$ $\Sigma = 114$ CFS

AT ELEV 1659

$2.7 \times 25 \times (1.8)^{1.5} = 163$

$2.7 \times 14 \times (.85)^{1.5} = 30$

$2.7 \times 20 \times (.15)^{1.5} = 3$

$2.7 \times 4 \times (.05)^{1.5} = -$

$2.7 \times 4 \times (.75)^{1.5} = 7$ $\Sigma = 203$ CFS

AT ELEV 1659.5

$2.7 \times 25 \times (2.3)^{1.5} = 235$

$2.7 \times 14 \times (1.35)^{1.5} = 59$

$2.7 \times 20 \times (.65)^{1.5} = 28$

$2.7 \times 4 \times (.55)^{1.5} = 4$

$2.7 \times 88 \times (.9)^{1.5} = 60$

$2.7 \times 7 \times (.1)^{1.5} = 1$

$2.7 \times 6 \times (1)^{1.5} = 16$ $\Sigma = 403$ CFS

AT ELEV 1660

$2.7 \times 25 \times (2.8)^{1.5} = 316$

$2.7 \times 14 \times (1.85)^{1.5} = 95$

$2.7 \times 20 \times (1.15)^{1.5} = 67$

$2.7 \times 4 \times (1.0)^{1.5} = 12$

$2.7 \times 88 \times (.9)^{1.5} = 203$

$2.7 \times 10 \times (.5)^{1.5} = 11$

$2.7 \times 22 \times (.2)^{1.5} = 5$

$2.7 \times 7 \times (1.3)^{1.5} = 26$ $\Sigma = 735$ CFS

BY RLS DATE 5/20/80 | BERGER ASSOCIATES | SHEET NO. 7 OF
CHKD. BY DATE | PROJECT D9650
SUBJECT ARROWHEAD LAKE

EMBANKMENT RATING (cont.)

AT ELEV. 1660.5

$2.7 \times 25 \times (3.3)^{1.5}$	=	405
$2.7 \times 14 \times (2.35)^{1.5}$	=	136
$2.7 \times 20 \times (1.65)^{1.5}$	=	114
$2.7 \times 4 \times (1.55)^{1.5}$	=	21
$2.7 \times 88 \times (1.4)^{1.5}$	=	394
$2.7 \times 10 \times (1.05)^{1.5}$	=	29
$2.7 \times 50 \times (.45)^{1.5}$	=	41
$2.7 \times 9 \times (1.9)^{1.5}$	=	45

Σ = 1185 cfs

AT ELEV. 1661

$2.7 \times 25 \times (3.8)^{1.5}$	=	500
$2.7 \times 14 \times (2.8)^{1.5}$	=	192
$2.7 \times 20 \times (2.15)^{1.5}$	=	170
$2.7 \times 4 \times (2.05)^{1.5}$	=	32
$2.7 \times 89 \times (1.9)^{1.5}$	=	622
$2.7 \times 10 \times (1.55)^{1.5}$	=	52
$2.7 \times 50 \times (.9)^{1.5}$	=	125
$2.7 \times 31 \times (.2)^{1.5}$	=	10
$2.7 \times 10 \times (1.75)^{1.5}$	=	63

Σ = 1756 cfs

AT ELEV 1662

$2.7 \times 25 \times (4.8)^{1.5}$	=	710
$2.7 \times 14 \times (3.35)^{1.5}$	=	286
$2.7 \times 20 \times (3.15)^{1.5}$	=	302
$2.7 \times 4 \times (3.05)^{1.5}$	=	58
$2.7 \times 89 \times (2.9)^{1.5}$	=	1173
$2.7 \times 10 \times (2.55)^{1.5}$	=	110
$2.7 \times 50 \times (1.1)^{1.5}$	=	156
$2.7 \times 19 \times (.35)^{1.5}$	=	11
$2.7 \times 13 \times (2.25)^{1.5}$	=	118
$2.7 \times 50 \times (1.9)^{1.5}$	=	368

Σ = 3292

BY RLS DATE 7/28/80 **BERGER ASSOCIATES** SHEET NO. 8 OF
CHKD. BY DATE PROJECT D9650
SUBJECT ARDON HEAD LAKE

DISCHARGE SUMMARY

ELEV.	SPILLWAY Q (CFS)	DROP INLET Q (CFS)	EMBANKMENT Q (CFS)	TOTAL Q (CFS)
1652	0	0	0	0
1652.5	151	3	0	154
1653	427	8	0	435
1653.5	784	15	0	799
1654	1207	23	0	1230
1655	2219	43	0	2261
1656	3414	66	0	3480
1656.9	4629	84	0	4713
1657.5	5505	86	11	5602
1658	6273	88	50	6411
1658.5	7073	89	114	7276
1659	7904	91	203	8198
1659.5	8764	92	403	9261
1660	9651	94	735	10486
1660.5	10577	95	1185	11857
1661	11524	97	1756	13377
1662	13497	100	3292	16889

BY RLS DATE 7/29/80 BERGER ASSOCIATES SHEET NO. 9 OF
CHKD. BY DATE PROJECT D9650
SUBJECT ARROWHEAD LAKE

UPSTREAM RESERVOIRS

LOCUST LAKE - 10' HIGH DAM
1000' LONG

TOP OF DAM = 1715
EMBANKMENT C = 2.7

3' SQUARE DROP INLET, CREST ELEV. = 1712
BROAD CRESTED WEIR C = 3.3
3' DIA. PIPE IN DROP INLET, INVERT = 1705
ORIFICE C = 0.6

ELEV.	SPILLWAY (CFS)	EMBANKMENT (CFS)	TOTAL (CFS)
1712	0	0	0
1712.5	14	0	14
1713	40	0	40
1713.5	73	0	73
1714	93	0	93
1715	99	0	99
1715.5	102	955	1057
1716	105	2700	2805
1716.5	108	4960	5068

BY RLS DATE 7/24/80 **BERGER ASSOCIATES** SHEET NO. 10 OF 1
CHKD. BY ____ DATE ____ PROJECT D965.0
SUBJECT ARROWHEAD LAKE

UPSTREAM RESERVOIRS

BRADY LAKE - 18' HIGH DAM
1340' LONG

LOW POINT, TOP OF DAM = 1717

SPILLWAY, CREST ELEV. = 1716
BROAD CRESTED WEIR C = 3.1
BOTTOM WIDTH = 41'
BRIDGE OVER WEIR - 2' CLEAR OPENING

STAGE DISCHARGE AND STAGE-STORAGE DATA FROM PENNDEP FILES

ELEV.	DISCHARGE (cfs)
1716	0
1717	127
1717.3	196
1717.7	337
1717.9	431
1718.3	652
1719	1267
1720	2736
1721	4842
1724	8224

ELEV.	STORAGE (AC-FT)
1699	0
1704	78
1709	300
1714	830
1716	1213
1720	2553
1724	4741

BY RLS DATE 7/29/80 | BERGER ASSOCIATES | SHEET NO. 11 OF 1
CHKD. BY DATE | PROJECT 0965.0
SUBJECT ARROWHEAD LAKE

UPSTREAM RESERVOIRS

BRADY LAKE - BREACH ASSUMPTIONS

BREACH WIDTH = 50'

SIDE SLOPES (EARTH EMBANKMENT) = 1:1

FAILURE TIME (EARTH EMBANKMENT) =
BETWEEN 15 MIN. AND 2 HR.
USE: .25 HR.

POOL LEVEL AT FAILURE: EARTH EMBANKMENT
SAY 0.5 FT OVER TOP OF DAM

BY RLS DATE 7/28/80 | BERGER ASSOCIATES | SHEET NO. 12 OF
CHKD. BY DATE | PROJECT D-9455C
SUBJECT ARROWHEAD LAKE

UPSTREAM RESERVOIRS

NORTH ARROWHEAD LAKE - 21' HIGH DAM

2 EMBANKMENTS TOTALING 2100' LONG

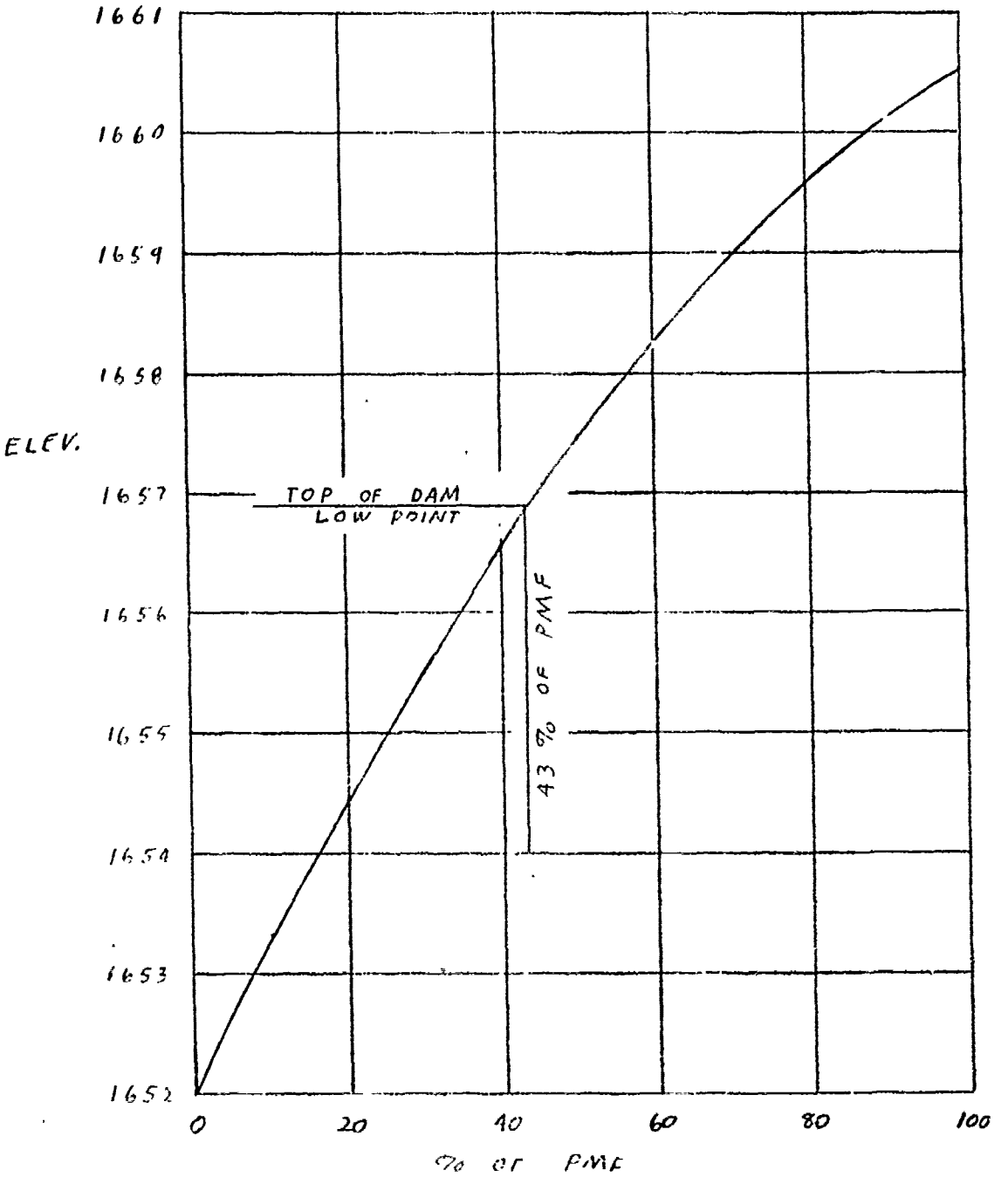
SPILLWAY - CONCRETE OGEE SECTION C = 3.88
LENGTH = 60'
CALC ELEV. = APPROX 1668.2

TOP OF DAM, LOW POINT = 1671.7
EMBANKMENT C = 2.7

ELEV.	SPILLWAY (CFS)	EMBANKMENT (CFS)	TOTAL (CFS)
1668.2	0	0	0
1669	167	0	167
1670	562	0	562
1671	1091	0	1091
1671.7	1524	0	1524
1672.5	2076	43	2119
1673	2448	172	2620
1674	3252	728	3980

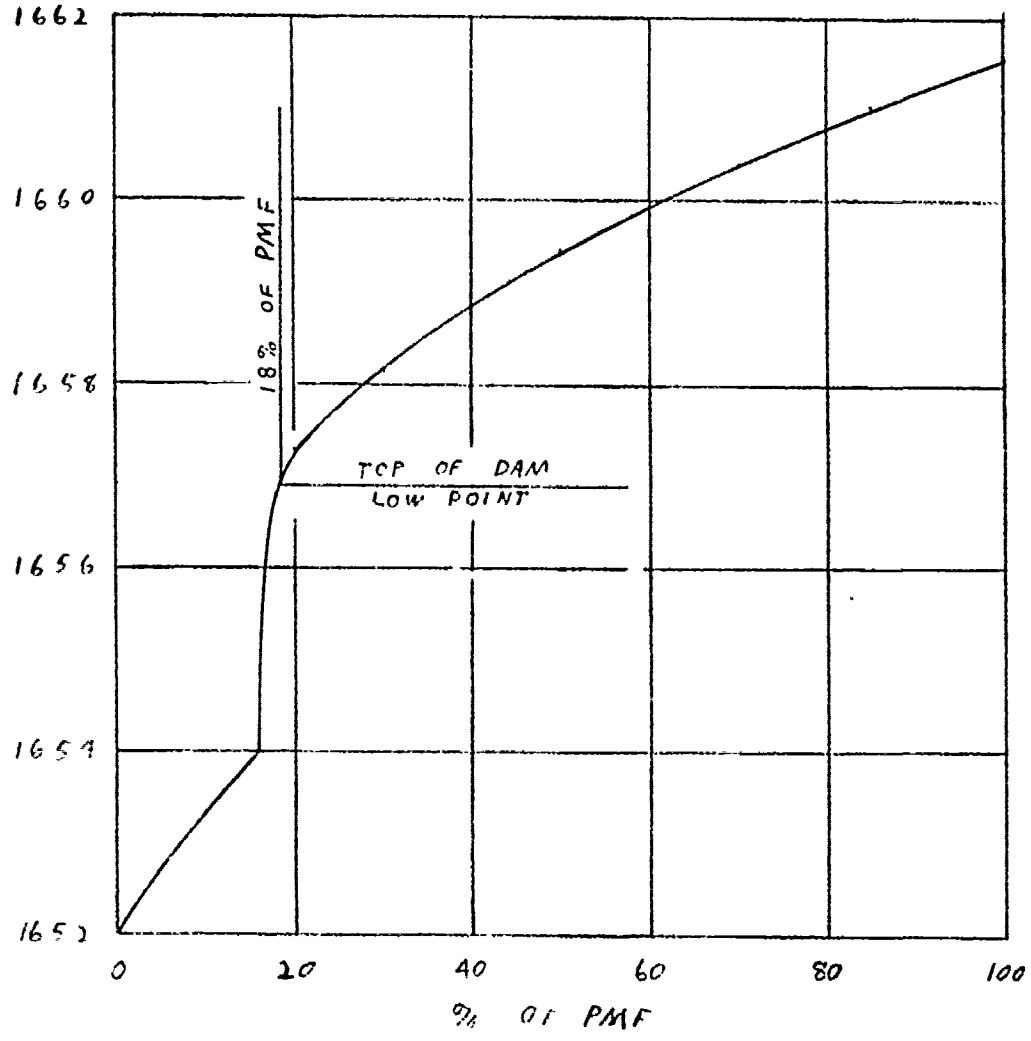
BY RLS DATE 5/22/80 **BERGER ASSOCIATES** SHEET NO. 13 OF 15
CHKD. BY DATE PROJECT D9650
SUBJECT ARROWHEAD LAKE

SPILLWAY CAPACITY CURVE



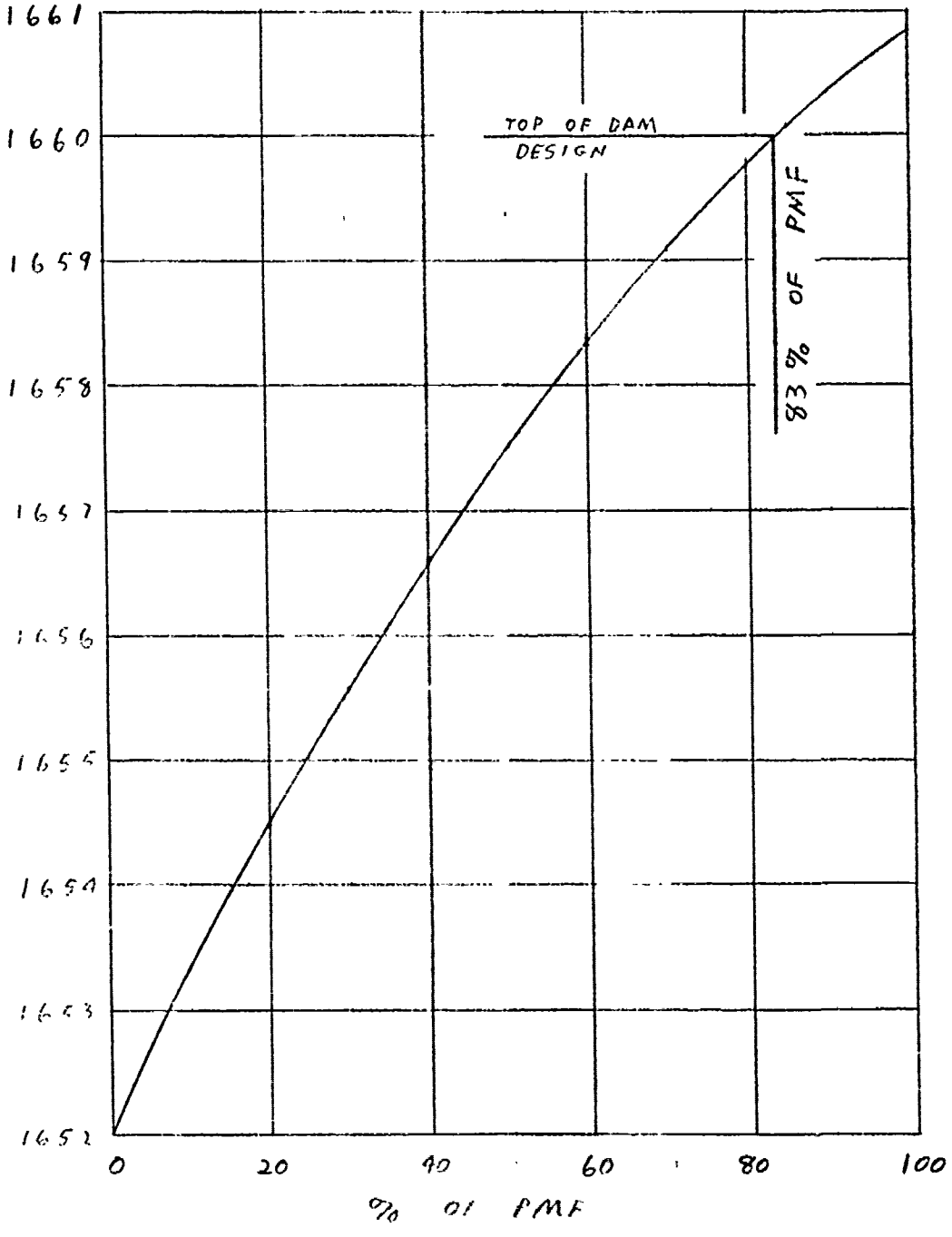
BY RLS DATE 5/22/80 **BERGER ASSOCIATES** SHEET NO. 11 OF 15
CHKD. BY DATE PROJECT D9650
SUBJECT ARROWHEAD LAKE

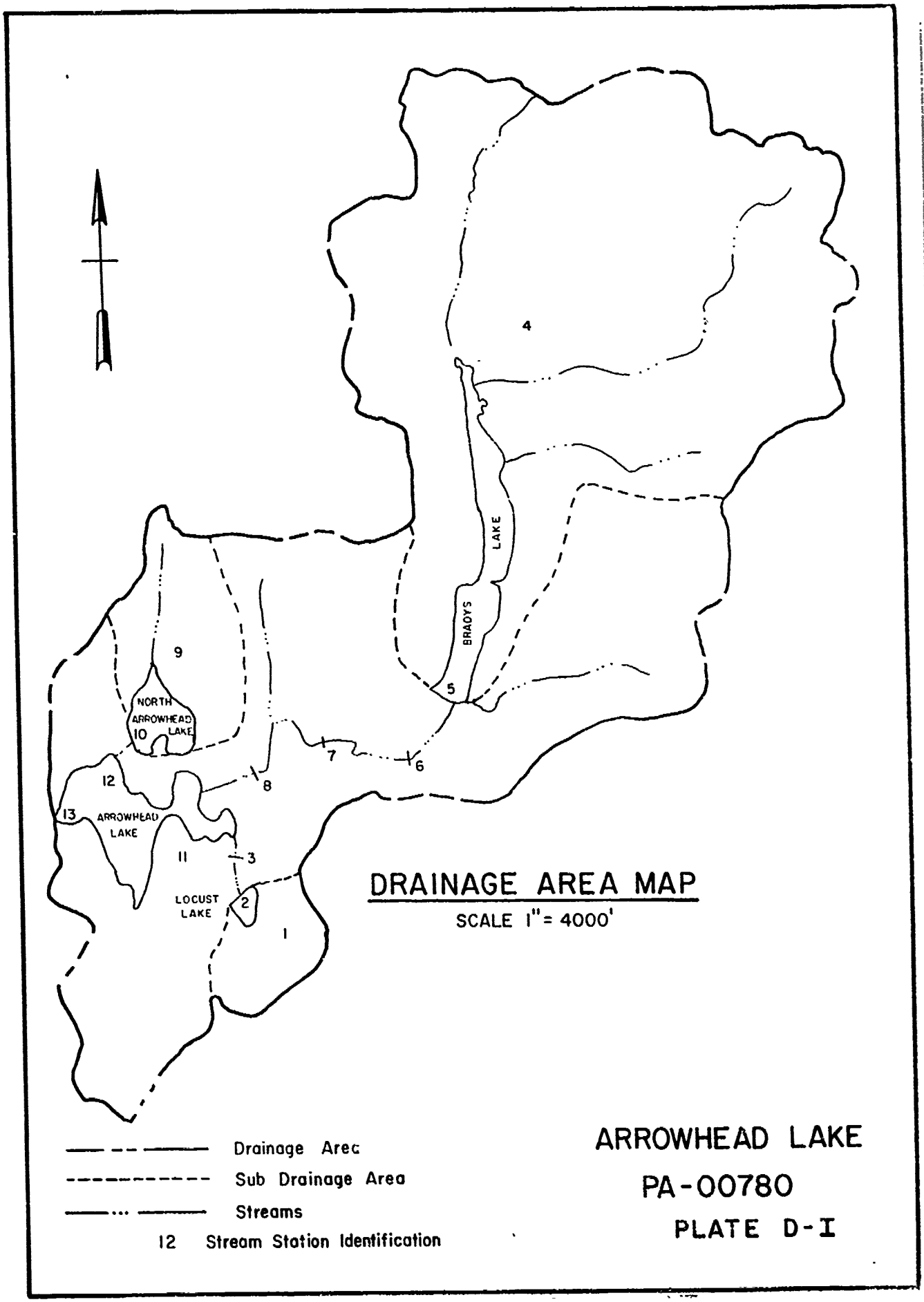
SPILLWAY CAPACITY CURVE WITH BADDY DAM FAILURE



BY RLS DATE 6/5/80 **BERGER ASSOCIATES** SHEET NO. 15 OF
CHKD. BY DATE PROJECT D9650
SUBJECT ARROW/REAR LAKE

SPILLWAY CAPACITY CURVE (DESIGN)




4
BRADYS
LAKE
5
9
NORTH
ARROWHEAD
LAKE
10
7
6
8
12
13
ARROWHEAD
LAKE
11
3
LOCUST
LAKE
2
1
DRAINAGE AREA MAP
SCALE 1" = 4000'
Drainage Area
Sub Drainage Area
Streams
12 Stream Station Identification
ARROWHEAD LAKE
PA-00780
PLATE D-I

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: ARROWHEAD LAKE RIVER BASIN: DELAWARE

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.1 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		LOCUST LAKE	LOCUST LAKE DAM	BRADY LAKE	BRADY LAKE DAM
DRAINAGE AREA (SQUARE MILES)		.42	-	7.53	-
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		.42	.42	7.53	7.53
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	107		107	
	12 HOURS	120		120	
	24 HOURS	128		128	
	48 HOURS	140		140	
	72 HOURS				
	Zone 1	-		-	
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	2		2	
	C_p / C_t[4]	.45/2.1		.45/2.1	
	L (MILES)[5]	.72		5.08	
	L_{ca} (MILES)[5]	.38		2.73	
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	1.42		4.62	
SPILLWAY DATA	CREST LENGTH (FT.)		3 (dia.)		41
	FREEBOARD (FT.)		3		1
	DISCHARGE COEFFICIENT		0.6		3.1
	EXPONENT		-		1.5
	ELEVATION		1712		1716
AREA[6] (ACRES)	NORMAL POOL	18.4		229	
	ELEV. _____	1720 = 25.3			
	ELEV. _____				
STORAGE (ACRE-FEET)	NORMAL POOL[7]	61.3		1213	
	ELEV. _____[8]	1720 = 0		1699 = 0	
	ELEV. _____[8]			1720 = 2553	
	ELEV _____[8]			1724 = 4741	

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: ARROWHEAD LAKE DAM RIVER BASIN: DELAWARE

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.1 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		NORTH ARROWHEAD LAKE	NORTH ARROWHEAD LAKE DAM	ARROWHEAD LAKE	ARROWHEAD LAKE DAM
DRAINAGE AREA (SQUARE MILES)		.89		5.9	
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		.89	.89	14.74	14.74
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	107		107	
	12 HOURS	120		120	
	24 HOURS	128		128	
	48 HOURS	140		140	
	72 HOURS	–		–	
	Zone 1				
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	2		2	
	C_p / C_t[4]	.45/2.1		.45/2.1	
	L (MILES)[5]	1.82		5.49	
	L_{ca} (MILES)[5]	.68		2.19	
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	2.24		4.43	
SPILLWAY DATA	CREST LENGTH (FT.)		60		11[illegible]
	FREEBOARD (FT.)		3.5		4.9
	DISCHARGE COEFFICIENT		3.88		3.88
	EXPONENT		1.5		1.5
	ELEVATION		1668.2		1652
AREA[6] (ACRES)	NORMAL POOL	82.6		217.6	
	ELEV. _____	1680 - 96.4		1660 = 364.6	
	ELEV _____			1680 = 649.2	
STORAGE ACRE-FEET)	NORMAL POOL[7]	413		1077	
	ELEV. _____[8]	1653.2 = 0		1637.2 = 0	
	ELEV. _____[8]				
	ELEV _____[8]				

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

(8) Computed by conic method.

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************
    1          A1       ARROWHEAD LAKE DAM    ****    TROUT CREEK
    2          A2       TOBYHANNA TWP., MONROE COUNTY, PA.
    3          A3       NDI # PA-00780        PA DER # 45-207
    4          B   300       0      15       0       0       0       0       0      -4       0
    5          B1    5
    6          J     1       9       1
    7          J1    1     .85      .7      .6      .5      .4      .3      .2      .1
    8          K             1                                               1
    9          K1                 INFLOW HYDROGRAPH - LOCUST LAKE SUBAREA
   10          M     1       1     .42           14.74
   11          P           22.1     107     120     128     140
   12          T                                                       1     .05
   13          W  1.42     .45
   14          X  -1.5    -.05       2
   15          K     1       2                                         1
   16          K1                 RESERVOIR ROUTING - THRU LOCUST LAKE
   17          Y                          1
   18          Y1    1                                                61.3    -1
   19          Y4 1712  1712.5    1713  1713.5    1714    1715  1715.5    1716  1716.5
   20          Y5    0      14      40      73      93      99    1057    2805    5068
   21          $A    0    18.4    25.3
   22          $E 1702    1712    1720
   23          $$ 1712
   24          $D 1715
   25          K     1       3                                         1
   26          K1                 ROUTING THRU REACH 2 - 3
   27          Y                          1
   28          Y1    1
   29          Y6   .1     .09      .1    1673    1720    1100    .033
   30          Y7    0    1700      10    1700     100    1680     140    1673     150    1673
   31          Y7  170    1680     470    1700     860    1720
   32          K             4                                         1
   33          K1                 INFLOW HYDROGRAPH - BRADY LAKE SUBAREA
   34          M     1       1    7.53           14.74
   35          P           22.1     107     120     128     140
   36          T                                                       1     .05
   37          W  4.62     .45
   38          X  -1.5    -.05       2
   39          K     1       5                                         1
   40          K1                 RESERVOIR ROUTING - THRU BRADY LAKE
   41          Y                          1
   42          Y1    1                                                1213    -1
   43          Y4 1716    1717  1717.3  1717.7  1717.9  1718.3    1719    1720    1721    1724
   44          Y5    0     127     196     337     431     652    1267    2736    4842    8224
   45          $S    0      78     300     830    1213    2553    4741
   46          $E 1699    1704    1709    1714    1716    1720    1724
   47          $$ 1716
   48          $D1717.7
   49          K     1       6                                         1
   50          K1                 ROUTING THRU REACH 5 - 6
1  51          Y                          1
   52          Y1    1
   53          Y6   .1     .08      .1    1701    1740    2500   .0043
   54          Y7    0    1740      10    1740     700    1720     910    1701     970    1701
   55          Y7 2820    1720    3900    1740    3910    1740
   56          K     1       7                                         1
   57          K1                 ROUTING THRU REACH 6 - 7
   58          Y                          1
```

```
 58  Y                                1
 59  Y1    1
 60  Y6   .1     .1      .1    1684   1720   2950   .0058
 61  Y7    0   1720      10    1720    260   1700   1670   1684   1680   1684
 62  Y7 2275   1700    3690    1720   3700   1720
 63  K     1      8                                  1
 64  K1                ROUTING THRU REACH 7 - 8
 65  Y                                1
 66  Y1    1
 67  Y6   .1    .09      .1    1663   1700   4650   .0045
 68  Y7    0   1700      10    1700    300   1680    480   1663    490   1663
 69  Y7  630   1680    1820    1700   1830   1700
 70  K             9                                  1
 71  K1                INFLOW HYDROGRAPH - NORTH ARROWHEAD LAKE SUBAREA
 72  M     1      1     .89           14.74
 73  P           22.1     107     120    128    140
 74  T                                             1    .05
 75  W  2.24    .45
 76  X  -1.5   -.05       2
 77  K     1     10                                  1
 78  K1                RESERVOIR ROUTING - THRU NORTH ARROWHEAD LAKE
 79  Y                                1
 80  Y1    1                                       413     -1
 81  Y41668.2   1669    1670    1671  1671.7  1672.5   1673   1674
 82  Y5    0    167     562    1091   1524    2119    2620   3980
 83  $A    0   82.6    96.4
 84  $E1653.2 1668.2   1680
 85  $$1668.2
 86  $D1671.7
 87  K             11                                 1
 88  K1                INFLOW HYDROGRAPH - ARROWHEAD LAKE SUBAREA
 89  M     1      1     5.9           14.74
 90  P           22.1     107     120    128    140
 91  T                                             1    .05
 92  W  4.43    .45
 93  X  -1.5   -.05       2
 94  K     4     12                                  1
 95  K1                COMBINE HYDROGRAPHS AT ARROWHEAD LAKE
 96  K     1     13                                  1
 97  K1                RESERVOIR ROUTING - THRU ARROWHEAD LAKE
 98  T                                1
 99  Y1    1                                      1977     -1
100  Y4 1652  1652.5    1653  1653.5    1654    1655   1656  1656.9  1657.5   1658
101  Y41658.5   1659  1659.5    1660  1660.5    1661   1662
102  Y5    0    154     435     799    1230    2261   3450   4713    5602   6411
103  Y5 7276   8198    9261   10486   11857   13377  16889
104  $A    0  217.6   364.6   649.2
105  $E1637.2   1652    1660    1680
106  $$ 1652
107  $D1656.9
108  K    99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
RUNOFF HYDROGRAPH AT	4
ROUTE HYDROGRAPH TO	5
ROUTE HYDROGRAPH TO	6
ROUTE HYDROGRAPH TO	7
ROUTE HYDROGRAPH TO	8
[illegible]	9

```
      99          Y1    1                                                1077     -1
     100          Y4 1652  1652.5    1653  1653.5    1654    1655    1656  1656.9  1657.5    1658
   1 101          Y41658.5   1659  1659.5    1660  1660.5    1661    1662
     102          Y5    0     154     435     799    1230    2261    3480    4713    5602    6411
     103          Y5 7276    8198    9261   10486   11857   13377   16889
     104          $A    0   217.6   364.6   649.2
     105          $E1637.2   1652    1660    1680    .
     106          $$ 1652
     107          $D1656.9
     108          K     99
   1                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                ROUTE HYDROGRAPH TO           3
                                RUNOFF HYDROGRAPH AT          4
                                ROUTE HYDROGRAPH TO           5
                                ROUTE HYDROGRAPH TO           6
                                ROUTE HYDROGRAPH TO           7
                                ROUTE HYDROGRAPH TO           8
                                RUNOFF HYDROGRAPH AT          9
                                ROUTE HYDROGRAPH TO          10
                                RUNOFF HYDROGRAPH AT         11
                                COMBINE  4 HYDROGRAPHS AT    12
                                ROUTE HYDROGRAPH TO          13
                                END OF NETWORK

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
**********************************

 RUN  DATE= 80/05/22.
      TIME= 07.54.21.


                ARROWHEAD LAKE DAM    ****    TROUT CREEK
                TOBYHANNA TWP., MONROE COUNTY, PA.
                NDI # PA-00780        PA DER # 45-207

                                JOB SPECIFICATION
          NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
         300       0      15       0       0       0       0       0      -4       0
                                JOPER     NWT   LROPT   TRACE
                                    5       0       0       0


                        MULTI-PLAN ANALYSES TO BE PERFORMED
                            NPLAN= 1 NRTIO= 9 LRTIO= 1
                RTIOS=  1.00    .85    .70    .60    .50    .40    .30    .20    .10


**********  **********  **********  **********  **********

                        SUB-AREA RUNOFF COMPUTATION

                    FLOW HYDROGRAPH - LOCUST LAKE SUBAREA
```

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LOCUST LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.42	0.00	14.74	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.10	107.90	120.00	128.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRTL	LSTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.42 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 52 END-OF-PERIOD ORDINATES, LAG= 1.43 HOURS, CP= .45 VOL= 1.09

5.	20.	41.	63.	77.	85.	81.	73.	65.	59.
53.	47.	42.	38.	34.	31.	27.	25.	22.	20.
18.	16.	14.	13.	11.	10.	9.	8.	7.	7.
6.	5.	5.	4.	4.	3.	3.	3.	3.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.								

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	25.16	22.74	2.42	24871.
	(639.)(	578.)(	61.)(	704.27)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LOCUST LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSAK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	61.	-1

STAGE	1712.00	1712.50	1713.00	1713.50	1714.00	1715.00	1715.50	1716.00	1716.50

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LOCUST LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSNK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	61.	-1

STAGE	1712.00	1712.50	1713.00	1713.50	1714.00	1715.00	1715.50	1716.00	1716.50
FLOW	0.00	14.00	40.00	73.00	93.00	99.00	1057.00	2805.00	5068.00
SURFACE AREA=	0.	18.	25.						
CAPACITY=	0.	61.	235.						
ELEVATION=	1702.	1712.	1720.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1712.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1715.0	0.0	0.0	0.

PEAK OUTFLOW IS 976. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 830. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 683. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 586. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 488. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 378. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 246. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 95. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 54. AT TIME 43.75 HOURS

HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0900	.1000	1673.0	1720.0	1100.	.03300

CROSS SECTION COORDINATES- A,ELEV,STA,ELEV--ETC
0.00 1700.00 10.00 1700.00 100.00 1680.00 1.50.00 1673.00 150.00 1673.00
170.00 1680.00 470.00 1700.00 860.00 1720.00

STORAGE	0.00	1.29	3.90	7.86	14.25	23.66	36.07	51.51	69.95	91.4
	115.88	143.42	174.54	208.68	245.83	285.99	329.16	375.35	424.55	476.7
OUTFLOW	0.00	209.72	938.92	2466.74	5451.56	10079.83	16751.44	25814.27	37587.32	52369.5
	70444.30	91359.60	117183.20	147383.68	182166.44	221742.77	266325.30	316125.83	371354.31	432218.7
STAGE	1673.00	1675.47	1677.95	1680.42	1682.89	1685.37	1687.84	1690.32	1692.79	1695.2
	1697.74	1700.21	1702.68	1705.16	1707.63	1710.11	1712.58	1715.05	1717.53	1720.0
FLOW	0.00	209.72	938.92	2466.74	5451.56	10079.83	16751.44	25814.27	37587.32	52369.5
	70444.30	91359.60	117183.20	147383.68	182166.44	221742.77	266325.30	316125.83	371354.31	432218.7

MAXIMUM STAGE IS 1678.0

MAXIMUM STAGE IS 1677.6

MAXIMUM STAGE IS 1677.1

MAXIMUM STAGE IS 1676.8

MAXIMUM STAGE IS 1676.5

MAXIMUM STAGE IS 1676.1

MAXIMUM STAGE IS 1675.6

IMUM STAGE IS 1674.1

MAXIMUM STAGE IS 1673.6

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - BRADY LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	7.53	0.00	14.74	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.10	107.00	120.00	128.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 4.62 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 4.66 HOURS, CP= .45 VOL= .95

5.	21.	43.	70.	100.	134.	169.	207.	246.	287.
327.	363.	395.	422.	445.	464.	477.	485.	486.	477.
461.	446.	431.	417.	403.	389.	376.	364.	352.	340.
328.	317.	307.	297.	287.	277.	268.	259.	250.	242.
234.	226.	218.	211.	204.	197.	191.	184.	178.	172.
166.	161.	155.	150.	145.	140.	136.	131.	127.	123.
118.	114.	111.	107.	103.	100.	97.	93.	90.	87.
84.	81.	79.	76.	74.	71.	69.	66.	64.	62.
60.	58.	56.	54.	52.	51.	49.	47.	46.	44.
43.	41.	40.	39.	37.	36.	35.	34.	33.	31.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 25.16 22.74 2.42 425146.
(639.)(578.)(61.)(12038.79)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU BRADY LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU BRADY LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1213.	-1

STAGE	1716.00	1717.00	1717.30	1717.70	1717.90	1718.30	1719.00	1720.00	1721.00	1724.0
FLOW	0.00	127.00	196.00	337.00	431.00	652.00	1267.00	2736.00	4842.00	8224.0
CAPACITY=	0.	78.	300.	830.	1213.	2553.	4741.			
ELEVATION=	1699.	1704.	1709.	1714.	1716.	1720.	1724.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1716.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1717.7	0.0	0.0	0.

PEAK OUTFLOW IS 6078. AT TIME 47.75 HOURS

PEAK OUTFLOW IS 5333. AT TIME 47.50 HOURS

PEAK OUTFLOW IS 4556. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 3860. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 3157. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 2427. AT TIME 47.75 HOURS

PEAK OUTFLOW IS 1636. AT TIME 48.50 HOURS

PEAK OUTFLOW IS 880. AT TIME 50.25 HOURS

K OUTFLOW IS 291. AT TIME 53.25 HOURS

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ROUTING THRU REACH 5 - 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSXK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.1000	.0800	.1000	1701.0	1740.0	2500.	.00430

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1740.00 10.00 1740.00 700.00 1720.00 910.00 1701.00 970.00 1701.00
2820.00 1720.00 3900.00 1740.00 3910.00 1740.00

STORAGE	0.00	20.18	66.57	139.18	238.01	363.06	514.32	691.80	895.50	1125.41
	1380.22	1656.57	1954.33	2273.49	2614.05	2976.01	3359.37	3764.13	4190.30	4637.86
OUTFLOW	0.00	496.59	2465.20	6606.67	13522.99	23756.02	37806.14	56142.71	79210.57	107434.50
	147267.25	195226.55	249484.25	310225.70	377624.11	451849.16	533069.50	621453.44	717169.11	820384.33
STAGE	1701.00	1703.05	1705.11	1707.16	1709.21	1711.26	1713.32	1715.37	1717.42	1719.47
	1721.53	1723.58	1725.63	1727.68	1729.74	1731.79	1733.84	1735.89	1737.95	1740.00
FLOW	0.00	496.59	2465.20	6606.67	13522.99	23756.02	37806.14	56142.71	79210.57	107434.50
	147267.25	195226.55	249484.25	310225.70	377624.11	451849.16	533069.50	621453.44	717169.11	820384.33

MAXIMUM STAGE IS 1706.9

MAXIMUM STAGE IS 1706.5

MAXIMUM STAGE IS 1706.1

MAXIMUM STAGE IS 1705.8

MAXIMUM STAGE IS 1705.4

MAXIMUM STAGE IS 1705.1

MAXIMUM STAGE IS 1704.2

MAXIMUM STAGE IS 1703.5

MAXIMUM STAGE IS 1702.2

ROUTING THRU REACH 6 - 7

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.1000	.1000	1684.0	1720.0	2950.	.00580

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1720.00 10.00 1720.00 260.00 1700.00 1670.00 1684.00 1680.00 1684.00
2275.00 1700.00 3690.00 1720.00 3700.00 1720.00

STORAGE	0.00	16.52	63.50	140.95	248.87	387.25	556.10	755.42	985.20	1243.87
	1523.80	1823.96	2144.36	2485.01	2845.89	3227.02	3628.38	4049.98	4491.83	4953.91
OUTFLOW	0.00	274.07	1651.35	4781.84	10204.92	18401.30	29812.64	44851.87	63909.53	90591.44
	124677.69	163838.56	208247.39	258065.33	313450.16	374558.57	441546.73	514570.31	593784.43	678656.45
STAGE	1684.00	1685.89	1687.79	1689.68	1691.58	1693.47	1695.37	1697.26	1699.16	1701.05
	1702.95	1704.84	1706.74	1709.63	1710.53	1712.42	1714.32	1716.21	1718.11	1720.00
FLOW	0.00	274.07	1651.35	4781.84	10204.92	18401.30	29812.64	44851.87	63909.53	90591.44
	124677.69	163839.56	208247.39	258065.33	313450.16	374558.57	441546.73	514570.31	593784.43	678656.45

MAXIMUM STAGE IS 1690.1

MAXIMUM STAGE IS 1689.9

MAXIMUM STAGE IS 1689.5

MAXIMUM STAGE IS 1689.1

MAXIMUM STAGE IS 1688.7

MAXIMUM STAGE IS 1688.3

MAXIMUM STAGE IS 1687.8

MAXIMUM STAGE IS 1686.7

MAXIMUM STAGE IS 1685.9

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HYDROGRAPH ROUTING

ROUTING THRU REACH 7 - 8

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0900	.1000	1663.0	1700.0	4650.	.00450

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1760.00 10.00 1700.00 300.00 1680.00 480.00 1663.00 490.00 1663.00
630.00 1680.00 1820.00 1700.00 1830.00 1700.00

STORAGE	0.00	5.89	19.40	40.53	69.28	105.65	149.64	201.24	260.47	328.14
	419.82	541.45	693.04	874.58	1086.08	1327.54	1598.96	1900.33	2231.66	2592.94
OUTFLOW	0.00	68.30	338.28	905.64	1852.66	3253.38	5176.21	7685.28	10841.42	14978.51
	20827.96	28074.26	37025.89	47946.24	61073.84	76630.52	94825.68	115859.00	139922.13	166593.41
STAGE	1663.00	1664.95	1666.89	1668.84	1670.79	1672.74	1674.68	1676.63	1678.58	1680.53
	1682.47	1684.42	1686.37	1688.32	1690.26	1692.21	1694.16	1696.11	1698.05	1700.00
FLOW	0.00	68.30	338.28	905.64	1852.66	3253.38	5176.21	7685.28	10841.42	14978.51
	20827.96	28074.26	37025.89	47946.24	61073.84	76630.52	94825.68	115859.00	139922.13	166593.41

MAXIMUM STAGE IS 1675.4

MAXIMUM STAGE IS 1674.8

MAXIMUM STAGE IS 1674.0

MAXIMUM STAGE IS 1673.3

MAXIMUM STAGE IS 1672.6

MAXIMUM STAGE IS 1671.6

MAXIMUM STAGE IS 1670.3

.MUM STAGE IS 1668.7

MAXIMUM STAGE IS 1666.5

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - NORTH ARROWHEAD LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.89	0.00	14.74	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.10	107.00	120.00	128.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.24 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 81 END-OF-PERIOD ORDINATES, LAG= 2.25 HOURS, CP= .45 VOL= 1.00

4.	14.	30.	47.	67.	86.	101.	112.	117.	115.
109.	101.	94.	88.	82.	76.	71.	66.	62.	58.
54.	50.	47.	44.	41.	38.	35.	33.	31.	29.
27.	25.	23.	22.	20.	19.	18.	16.	15.	14.
13.	12.	12.	11.	10.	9.	9.	8.	8.	7.
7.	6.	6.	5.	5.	5.	4.	4.	4.	3.
3.	3.	3.	3.	2.	2.	2.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.									

0 END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.16	22.74	2.42	52219.
										(639.)	(578.)	(61.)	(1478.68)

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU NORTH ARROWHEAD LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	2.000	413.	1

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU NORTH ARROWHEAD LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSAK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	413.	-1

STAGE	1668.20	1669.00	1670.00	1671.00	1671.70	1672.50	1673.00	1674.00
FLOW	0.00	167.00	562.00	1091.00	1524.00	2119.00	2620.00	3980.00
SURFACE AREA=	0.	83.	96.					
CAPACITY=	0.	413.	1468.					
ELEVATION=	1653.	1668.	1680.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1668.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1671.7	0.0	0.0	0.

PEAK OUTFLOW IS 1310. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 1088. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 884. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 745. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 599. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 467. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 339. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 206. AT TIME 44.75 HOURS

PEAK OUTFLOW IS 96. AT TIME 45.00 HOURS

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - ARROWHEAD LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	0	0	0	0	0	10	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	IRSDA	IRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.90	0.00	14.74	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.10	107.00	120.00	128.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 4.43 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.59 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 4.44 HOURS, CP= .45 VOL= .96

5.	18.	37.	6'.	87.	116.	147.	179.	214.	248.
281.	309.	335.	356.	373.	386.	394.	397.	390.	378.
365.	352.	340.	328.	317.	306.	295.	285.	275.	265.
256.	247.	239.	230.	222.	215.	207.	200.	193.	186.
180.	174.	168.	162.	156.	151.	146.	141.	136.	131.
126.	122.	118.	114.	110.	106.	102.	99.	95.	92.
89.	86.	83.	80.	77.	74.	72.	69.	67.	65.
62.	60.	58.	56.	54.	52.	50.	47.	47.	45.
44.	42.	41.	39.	38.	37.	35.	34.	33.	32.
31.	30.	29.	28.	27.	26.	25.	24.	23.	22.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	25.16	22.74	2.42	334992.
	(639.)	(578.)	(61.)	(9485.92)

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT ARROWHEAD LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
12	4	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU ARROWHEAD LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
13	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1077.	-1

STAGE	1652.00	1652.50	1653.00	1653.50	1654.00	1655.00	1656.00	1656.90	1657.
	1658.50	1659.00	1659.50	1660.00	1660.50	1661.00	1662.00		
FLOW	0.00	154.00	435.00	799.00	1230.00	2261.00	3480.00	4713.00	5602.0
	7276.00	8198.00	9261.00	10486.00	11857.00	13377.00	16889.00		
SURFACE AREA=	0.	218.	365.	649.					
CAPACITY=	0.	1073.	3377.	13379.					
ELEVATION=	1637.	1652.	1660.	1680.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1652.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1656.9	0.0	0.0	0.

PEAK OUTFLOW IS 11914. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 10074. AT TIME 47.75 HOURS

PEAK OUTFLOW IS 8147. AT TIME 48.25 HOURS

PEAK OUTFLOW IS 6845. AT TIME 48.50 HOURS

PEAK OUTFLOW IS 5539. AT TIME 49.00 HOURS

PEAK OUTFLOW IS 4236. AT TIME 49.50 HOURS

PEAK OUTFLOW IS 2905. AT TIME 50.00 HOURS

PEAK OUTFLOW IS 1674. AT TIME 50.50 HOURS

PEAK OUTFLOW IS 668. AT TIME 49.75 HOURS

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	.42	1	982.	834.	687.	589.	491.	393.	294.	196.	98.
	(	1.09)	(	27.80)(	23.63)(	19.46)(	16.68)(	13.90)(	11.12)(	8.34)(	5.56)(	2.78)
ROUTED TO	2	.42	1	976.	830.	683.	586.	488.	378.	246.	95.	54.
	(	1.09)	(	27.63)(	23.49)(	19.34)(	16.58)(	13.81)(	10.72)(	6.98)(	2.68)(	1.52)
ROUTED TO	3	.42	1	977.	829.	678.	592.	510.	399.	259.	95.	54.
	(	1.09)	(	27.67)(	23.46)(	19.21)(	16.76)(	14.43)(	11.30)(	7.35)(	2.68)(	1.52)
HYDROGRAPH AT	4	7.53	1	8511.	7234.	5958.	5107.	4256.	3404.	2553.	1702.	851.
	(	19.50)	(	241.01)(	204.86)(	168.71)(	144.60)(	120.50)(	96.40)(	72.30)(	48.20)(	24.10)
ROUTED TO	5	7.53	1	6078.	5333.	4556.	3860.	3157.	2427.	1636.	880.	291.
	(	19.50)	(	172.11)(	151.02)(	129.02)(	109.31)(	89.41)(	68.73)(	46.33)(	24.93)(	8.23)
ROUTED TO	6	7.53	1	6075.	5330.	4552.	3856.	3155.	2423.	1633.	879.	290.
	(	19.50)	(	172.02)(	150.94)(	128.90)(	109.20)(	89.33)(	68.61)(	46.24)(	24.90)(	8.21)
ROUTED TO	7	7.53	1	6071.	5327.	4544.	3849.	3149.	2418.	1626.	877.	290.
	(	19.50)	(	171.90)(	150.84)(	128.67)(	109.00)(	89.16)(	68.47)(	46.04)(	24.83)(	8.21)
ROUTED TO	8	7.53	1	6067.	5323.	4537.	3843.	3142.	2412.	1621.	874.	289.
	(	19.50)	(	171.79)(	150.74)(	128.47)(	108.81)(	88.99)(	68.31)(	45.89)(	24.76)(	8.18)
HYDROGRAPH AT	9	.89	1	1630.	1386.	1141.	978.	815.	652.	489.	326.	163
	(	2.31)	(	46.16)(	39.24)(	32.31)(	27.70)(	23.08)(	18.47)(	13.85)(	9.23)(	4.62)
ROUTED TO	10	.89	1	1310.	1069.	894.	745.	599.	467.	339.	206.	96
	(	2.31)	(	37.09)(	30.81)(	25.92)(	21.08)(	16.96)(	13.22)(	9.61)(	5.84)(	2.72)
HYDROGRAPH AT	11	5.99	1	6871.	5841.	4810.	4123.	3436.	2749.	2061.	1374.	687.
	(	15.28)	(	194.58)(	165.39)(	136.20)(	116.75)(	97.29)(	77.83)(	58.37)(	38.92)(	19.46
4 COMBINED	12	14.74	1	13133.	11234.	9150.	7709.	6265.	4755.	3183.	1826.	693.
	(	38.18)	(	371.88)(	318.11)(	259.09)(	218.29)(	177.41)(	134.64)(	90.13)(	51.70)(	25.27
ROUTED TO	13	14.74	1	11914.	10074.	8147.	6845.	5539.	4236.	2905.	1674.	668.
	(	38.18)	(	337.38)(	285.27)(	230.70)(	193.84)(	156.83)(	119.95)(	82.25)(	47.41)(	18.90)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1711.99	1712.00	1715.00
STORAGE	61.	61.	120.
OUTFLOW	0.	0.	99.

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1711.99	1712.90	1715.00
STORAGE	61.	61.	120.
OUTFLOW	0.	0.	99.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1715.46	.46	130.	976.	9.25	41.25	0.00
.85	1715.38	.38	128.	830.	8.50	41.25	0.00
.70	1715.30	.30	127.	683.	7.50	41.25	0.00
.60	1715.25	.25	126.	586.	6.50	41.25	0.00
.50	1715.20	.20	124.	488.	5.75	41.25	0.00
.40	1715.15	.15	123.	378.	4.75	41.50	0.00
.30	1715.08	.08	122.	246.	3.00	42.50	0.00
.20	1714.29	0.00	106.	95.	0.00	44.00	0.00
.10	1713.21	0.00	84.	54.	0.00	43.75	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	977.	1678.0	41.25
.85	829.	1677.6	41.25
.70	678.	1677.1	41.50
.60	592.	1676.8	41.25
.50	510.	1676.5	41.25
.40	399.	1676.1	41.75
.30	259.	1675.6	42.75
.20	95.	1674.1	44.00
.10	54.	1673.6	43.75

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1716.00	1716.00	1717.70
STORAGE	1213.	1213.	1782.
OUTFLOW	0.	0.	337.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1722.10	4.40	3700.	6078.	35.25	47.75	0.00
.85	1721.44	3.74	3338.	5333.	33.75	47.50	0.00
.70	1720.86	3.16	3026.	4556.	32.00	47.25	0.00
.69	1720.53	2.83	2845.	3860.	30.75	47.25	0.00
.50	1720.20	2.50	2662.	3157.	29.25	47.25	0.00
.40	1719.79	2.09	2483.	2427.	27.50	47.75	0.00
.30	1719.25	1.55	2302.	1636.	25.00	48.50	0.00
.20	1718.56	.86	2071.	880.	20.50	50.25	0.00
.10	1717.57	0.00	1738.	271.	0.00	53.25	0.00

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6075.	1706.9	48.00
.85	5330.	1706.5	47.75
.70	4552.	1706.1	47.25
.60	3856.	1705.8	47.50
.50	3155.	1705.4	47.50
.40	2423.	1705.1	46.00
.30	1633.	1704.2	48.75
.20	879.	1703.5	50.50
.10	290.	1702.2	53.75

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6071.	1690.1	48.25
.85	5327.	1689.9	48.00
.70	4544.	1689.5	47.75
.60	3849.	1689.1	47.75
.50	3149.	1688.7	48.00
.40	2418.	1688.3	48.25
.30	1626.	1687.8	49.25
.20	877.	1686.7	51.00
.10	290.	1685.9	54.25

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6067.	1675.4	48.50
.85	5323.	1674.8	48.25
.70	4537.	1674.0	48.00
.60	3843.	1673.3	48.00
.50	3142.	1672.6	48.25
.40	2412.	1671.6	48.75
.30	1621.	1670.3	49.75
.20	874.	1668.7	51.50
.10	289.	1666.5	55.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1668.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.97	0.00	649.	1099.	0.00	43.75	0.00

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1668.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.99	0.00	648.	1088.	0.00	43.75	0.00
.70	1670.61	0.00	615.	884.	0.00	44.00	0.00
.60	1670.35	0.00	593.	745.	0.00	44.00	0.00
.50	1670.07	0.00	569.	599.	0.00	44.00	0.00
.40	1669.76	0.00	543.	467.	0.00	44.25	0.00
.30	1669.44	0.00	516.	337.	0.00	44.25	0.00
.20	1669.10	0.00	488.	206.	0.00	44.75	0.00
.10	1668.66	0.00	451.	96.	0.00	45.00	0.00

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1652.01	1652.00	1656.90
STORAGE	1076.	1073.	2344.
OUTFLOW	4.	0.	4713.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1660.52	3.62	3568.	11714.	17.25	47.25	0.00
.85	1659.83	2.93	3316.	10074.	15.25	47.75	0.00
.70	1658.97	2.07	3013.	8147.	12.[illegible]	48.25	0.00
.60	1658.25	1.35	2771.	6845.	10.25	48.50	0.00
.50	1657.46	.56	2515.	5539.	6.75	49.00	0.00
.40	1656.55	0.00	2239.	4236.	0.00	49.50	0.00
.30	1655.53	0.00	1945.	2903.	0.00	50.00	0.00
.20	1654.43	0.00	1651.	1674.	0.00	50.50	0.00
.10	1653.32	0.00	1375.	668.	0.00	49.75	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****
EOI ENCOUNTERED.
N>

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LAST MODIFICATION  26 FEB 79
**********************************
   1          A1       ARROWHEAD LAKE DAM    ****    TROUT CREEK
   2          A2       TOBYHANNA TWP., MONROE COUNTY, PA.
   3          A3       NDI # PA-00780        PA DER # 45-207
   4          B   300      0      15       0       0       0       0       0      -4       0
   5          B1    5
   6          J     1      9       1
   7          J1    1    .85      .7      .6      .5      .4      .3      .2      .1
   8          K              1                                                1
   9          K1                    INFLOW HYDROGRAPH - LOCUST LAKE SUBAREA
  10          M     1      1     .42           14.74
  11          P          22.1     107     120     128     140
  12          T                                                       1     .05
  13          W  1.42     .45
  14          X  -1.5    -.05       2
  15          K     1      2                                          1
  16          K1                    RESERVOIR ROUTING - THRU LOCUST LAKE
  17          Y                              1
  18          Y1    1                                                61.3     -1
  19          Y4 1712  1712.5    1713  1713.5    1714    1715  1715.5    1716  1716.5
  20          Y5    0      14      40      73      93      99    1057    2805    5068
  21          $A    0    18.4    25.3
  22          $E 1702    1712    1720
  23          $$ 1712                                                     1
  24          $D 1715
  25          K     1      3                                          1
  26          K1                    ROUTING THRU REACH 2 - 3
  27          Y                              1
  28          Y1    1
  29          Y6   .1     .09      .1    1673    1720    1100    .033
  30          Y7    0    1700      10    1700     100    1680     140    1673     150    1673
  31          Y7  170    1680     470    1700     860    1720
  32          K              4                                          1
  33          K1                    INFLOW HYDROGRAPH - BRADY LAKE SUBAREA
  34          M     1      1    7.53           14.74
  35          P          22.1     107     120     128     140
  36          T                                                       1     .05
  37          W  4.62     .45
  38          X  -1.5    -.05       2
  39          K     1      5                                          1
  40          K1                    RESERVOIR ROUTING - THRU BRADY LAKE
  41          Y                              1
  42          Y1    1                                                1215     -1
  43          Y4 1716    1717  1717.3  1717.7  1717.9  1718.3    1719    1720    1721    1724
  44          Y5    0     127     196     337     431     652    1207    2736    4842    8224
  45          $S    0      78     300     830    1213    2553    4741
  46          $E 1699    1704    1709    1714    1716    1720    1724
  47          $$ 1716
  48          $D1717.7
  49          $R   50       1    1704     .25    1716  1718.2
  50          K     1      6                                          1
  51          K1                    ROUTING THRU REACH 5 - 6
  52          Y                              1
  53          Y1    1
  54          Y6   .1     .08      .1    1701    1740    2500   .0043
  55          Y7    0    1740      10    1740     700    1720     910    1701     970    1701
  56          Y7 2820    1720    3900    1740    3910    1740
  57          K     1      7                                          1
  58          K1                    ROUTING THRU REACH 6 - 7
  59          Y                              1
  60          Y1    1
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KI                ROUTING THRU REACH 6 - 7
Y                          1
Y1    1
Y6   .1     .1      .1    1684   1720   2950   .0058
Y7    0    1720      10    1720    260   1700   1670   1684   1680   1684
Y7 2275    1700    3690    1720   3700   1720
K     1       8                                    1
KI                ROUTING THRU REACH 7 - 8
Y                          1
Y1    1
Y6   .1     .09     .1    1663   1700   4650   .0045
Y7    0    1700      10    1700    300   1680    480   1663    490   1663
Y7  630    1680    1820    1700   1830   1700
K             9                                    1
KI                INFLOW HYDROGRAPH - NORTH ARROWHEAD LAKE SUBAREA
M     1       1     .89           14.74
P            22.1    107    120    128    140
T                                                 1    .05
W  2.24     .45
X  -1.5    -.05      2
K     1      10                                    1
KI                RESERVOIR ROUTING - THRU NORTH ARROWHEAD LAKE
Y                          1
Y1    1                                          413     -1
Y41668.2   1669    1670    1671  1671.7  1672.5   1673   1674
Y5    0     167     562    1091   1524    2119   2620   3980
$A    0    82.6    96.4
$E1653.2 1668.2   1680
$$1668.2
$D1671.7
K            11                                    1
KI                INFLOW HYDROGRAPH - ARROWHEAD LAKE SUBAREA
M     1       1     5.9           14.74
P            22.1    107    120    128    140
T                                                 1    .05
W  4.43     .45
X  -1.5    -.05      2
K     4      12                                    1
KI                COMBINE HYDROGRAPHS AT ARROWHEAD LAKE
K     1      13                                    1
KI                RESERVOIR ROUTING - THRU ARROWHEAD LAKE
Y                          1
Y1    1                                         1077     -1
Y4  1652  1652.5    1653   1653.5   1654   1655   1656  1656.9  1657.5   1658
Y41658.5   1659  1659.5    1660  1660.5   1661   1662
Y5    0     154     435     799   1230    2261   3480   4713   5602   6411
Y5 7276    8198    9261   10486  11857   13377  16889
$A    0   217.6   364.6   649.2
$E1637.2   1652    1660    1680
$$ 1652
$D1656.9
K    99

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                RUNOFF HYDROGRAPH AT        1
                ROUTE HYDROGRAPH TO         2
                ROUTE HYDROGRAPH TO         3
                RUNOFF HYDROGRAPH AT        4
                ROUTE HYDROGRAPH TO         5
                ROUTE HYDROGRAPH TO         6
                ROUTE HYDROGRAPH TO         7
                ROUTE HYDROGRAPH TO         8
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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
RUNOFF HYDROGRAPH AT	4
ROUTE HYDROGRAPH TO	5
ROUTE HYDROGRAPH TO	6
ROUTE HYDROGRAPH TO	7
ROUTE HYDROGRAPH TO	8
RUNOFF HYDROGRAPH AT	9
ROUTE HYDROGRAPH TO	10
RUNOFF HYDROGRAPH AT	11
COMBINE 4 HYDROGRAPHS AT	12
ROUTE HYDROGRAPH TO	13
END OF NETWORK	

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE* 80/05/27.
TIME* 10.43.02.

ARROWHEAD LAKE DAM **** TROUT CREEK
TOBYHANNA TWP., MONROE COUNTY, PA.
NDI # PA-00780 PA DER # 45-207

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= 1.00 .85 .70 .60 .50 40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LOCUST LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.42	0.00	14.74	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	.42	1	982.	834.	687.	589.	491.	393.	294.	196.	98.
	(	1.09)	(	27.80)(	23.63)(	19.46)(	16.68)(	13.90)(	11.12)(	8.34)(	5.56)(	2.78)
ROUTED TO	2	.42	1	976.	830.	683.	586.	488.	378.	246.	95.	54.
	(	1.09)	(	27.63)(	23.49)(	19.34)(	16.58)(	13.81)(	10.72)(	6.98)(	2.68)(	1.52)
ROUTED TO	3	.42	1	977.	829.	678.	592.	510.	399.	259.	95.	54.
	(	1.09)	(	27.67)(	23.46)(	19.21)(	16.76)(	14.43)(	11.30)(	7.35)(	2.68)(	1.52)
HYDROGRAPH AT	4	7.53	1	8511.	7234.	5958.	5107.	4256.	3404.	2553.	1702.	851.
	(	19.50)	(	241.01)(	204.86)(	168.71)(	144.60)(	120.50)(	96.40)(	72.30)(	48.20)(	24.10)
ROUTED TO	5	7.53	1	10720.	10695.	10580.	10611.	10813.	10534.	10613.	10381.	291.
	(	19.50)	(	303.55)(	302.85)(	299.58)(	300.48)(	306.18)(	298.29)(	300.52)(	293.97)(	8.23)
ROUTED TO	6	7.53	1	9603.	9602.	9502.	9527.	9685.	9401.	9390.	9094.	290.
	(	19.50)	(	271.93)(	271.91)(	269.08)(	269.78)(	274.25)(	266.20)(	265.90)(	257.52)(	8.21)
ROUTED TO	7	7.53	1	9032.	9040.	8944.	8957.	9074.	8788.	8718.	8383.	290.
	(	19.50)	(	255.77)(	255.98)(	253.27)(	253.64)(	256.95)(	248.85)(	246.86)(	237.39)(	8.21)
ROUTED TO	8	7.53	1	8749.	8753.	8652.	8662.	8778.	8484.	8412.	8067.	289.
	(	19.50)	(	247.75)(	247.87)(	244.98)(	245.27)(	248.58)(	240.24)(	238.21)(	228.42)(	8.18)
HYDROGRAPH AT	9	.89	1	1630.	1386.	1141.	978.	815.	652.	489.	326.	163.
	(	2.31)	(	46.16)(	39.24)(	32.31)(	27.70)(	23.08)(	18.47)(	13.85)(	9.23)(	4.62)
ROUTED TO	10	.89	1	1310.	1088.	884.	745.	599.	467.	339.	206.	96.
	(	2.31)	(	37.09)(	30.81)(	25.02)(	21.08)(	16.96)(	13.22)(	9.61)(	5.84)(	2.72)
HYDROGRAPH AT	11	5.90	1	6871.	5841.	4810.	4123.	3436.	2749.	2061.	1374.	687.
	(	15.28)	(	194.58)(	165.39)(	136.20)(	116.75)(	97.29)(	77.83)(	58.37)(	38.92)(	19.46)
4 COMBINED	12	14.74	1	16602.	15353.	14361.	13752.	13079.	11876.	10699.	9243.	893.
	(	38.18)	(	470.12)(	434.76)(	406.66)(	389.41)(	370.35)(	336.29)(	302.95)(	261.72)(	25.27)
ROUTED TO	13	14.74	1	15340.	13527.	11584.	10364.	9198.	7859.	6653.	5292.	668.
	(	38.18)	(	434.39)(	383.03)(	328.03)(	293.47)(	260.46)(	222.54)(	188.39)(	149.85)(	18.90)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1711.99	1712.00	1715.00
	STORAGE	61.	61.	120.
	OUTFLOW	0.	0	00

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1711.99	1712.00	1715.00
STORAGE	61.	61.	120.
OUTFLOW	0.	0.	99.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1715.46	.46	130.	976.	9.25	41.25	0.00
.85	1715.38	.38	128.	830.	8.50	41.25	0.00
.70	1715.30	.30	127.	683.	7.50	41.25	0.00
.60	1715.25	.25	126.	586.	6.50	41.25	0.00
.50	1715.20	.20	124.	488.	5.75	41.25	0.00
.40	1715.15	.15	123.	378.	4.75	41.50	0.00
.30	1715.08	.08	122.	246.	3.00	42.50	0.00
.20	1714.29	0.00	106.	95.	0.00	44.00	0.00
.10	1713.21	0.00	84.	54.	0.00	43.75	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	977.	1678.0	41.25
.85	829.	1677.6	41.25
.70	678.	1677.1	41.50
.60	592.	1676.8	41.25
.50	510.	1676.5	41.25
.40	399.	1676.1	41.75
.30	259.	1675.6	42.75
.20	95.	1674.1	44.00
.10	54.	1673.6	43.75

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1716.00	1716.00	1717.70
STORAGE	1213.	1213.	1782.
OUTFLOW	0.	0.	337.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1718.34	.64	1998.	10720.	2.00	40.25	40.00
.85	1718.32	.62	1991.	10695.	1.75	40.75	40.50
.70	1718.25	.55	1967.	10580.	1.50	41.25	41.00
.60	1718.27	.57	1973.	10611.	1.50	41.75	41.50
.50	1718.39	.69	2013.	10813.	1.75	42.50	42.25
.40	1718.24	.54	1962.	10534.	1.49	43.00	42.75
.30	1718.31	.61	1985.	10613.	1.74	44.25	44.00
.20	1718.22	.52	1956.	10381.	2.40	46.50	46.25
.10	1717.57	0.00	1738.	291.	0.00	53.25	0.00

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	9603.	1708.0	40.75
.85	9602.	1708.0	41.25
.70	9502.	1708.0	41.75
.60	9527.	1708.0	42.25
.50	9685.	1708.1	43.00
.40	9401.	1708.0	43.50
.30	9390.	1708.0	44.75
.20	9094.	1707.9	47.00
.10	290.	1702.2	53.75

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	9032.	1691.2	41.25
.85	9040.	1691.2	41.75
.70	8944.	1691.1	42.25
.60	8957.	1691.1	42.75
.50	9074.	1691.2	43.50
.40	8788.	1691.1	44.00
.30	8718.	1691.1	45.25
.20	8383.	1690.9	47.50
.10	290.	1685.9	54.25

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	8749.	1677.3	41.50
.85	8753.	1677.3	42.00
.70	8652.	1677.2	42.50
.60	8662.	1677.2	43.00
.50	8778.	1677.3	43.75
.40	8484.	1677.1	44.25
.30	8412.	1677.1	45.50
.20	8067.	1676.9	47.75
.10	289.	1666.5	55.00

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1668.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.99	0.00	648.	1088.	0.00	43.75	0.00

1.00	8749.	1677.3	41.50
.85	8753.	1677.3	42.00
.70	8652.	1677.2	42.50
.60	8662.	1677.2	43.00
.50	8778.	1677.3	43.75
.40	8484.	1677.1	44.25
.30	8412.	1677.1	45.50
.20	8067.	1676.9	47.75
.10	289.	1666.5	55.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1668.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.99	0.00	648.	1088.	0.00	43.75	0.00
.70	1670.61	0.00	615.	884.	0.00	44.00	0.00
.60	1670.35	0.00	593.	745.	0.00	44.00	0.00
.50	1670.07	0.00	569.	599.	0.00	44.00	0.00
.40	1669.76	0.00	543.	467.	0.00	44.25	0.00
.30	1669.44	0.00	516.	339.	0.00	44.25	0.00
.20	1669.10	0.00	488.	206.	0.00	44.75	0.00
.10	1668.66	0.00	451.	96.	0.00	45.00	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1652.01	1652.00	1656.90
STORAGE	1076.	1073.	2344.
OUTFLOW	4.	0.	4713.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1661.56	4.66	3961.	15340.	17.25	45.75	0.00
.85	1661.04	4.14	3764.	13527.	15.50	46.00	0.00
.70	1660.40	3.50	3524.	11584.	13.75	46.00	0.00
.60	1659.95	3.05	3359.	10364.	12.00	46.25	0.00
.50	1659.47	2.57	3187.	9198.	10.00	46.50	0.00
.40	1658.82	1.92	2960.	7859.	8.00	46.75	0.00
.30	1658.14	1.24	2734.	6653.	5.50	47.75	0.00
.20	1657.29	.39	2463.	5292.	2.50	49.75	0.00
.10	1653.32	0.00	1375.	668.	0.00	49.75	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
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EOI ENCOUNTERED.
M>

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1    A1       ARROWHEAD LAKE DAM    ####    TROUT CREEK
2    A2       TOBYHANNA TWP., MONROE COUNTY, PA.
3    A3       NDI # PA-00780        PA DER # 45-207
4    P   300      0      15       0       0       0       0       0      -4       0
5    B1    5
6    J     1      9       1
7    J1    1    .85      .7      .6      .5      .4      .3      .2      .1
8    K             1                                       1
9    M1                    INFLOW HYDROGRAPH - LOCUST LAKE SUBAREA
10   M     1      1      .42           14.74
11   P           22.1     107     120     128     140
12   T                                                    1     .05
13   W  1.42     .45
14   X  -1.5    -.05       2
15   K     1      2                                       1
16   M1                    RESERVOIR ROUTING - THRU LOCUST LAKE
17   Y                             1
18   Y1    1                                                61.3     -1
19   Y4 1712  1712.5    1713  1713.5    1714    1715  1715.5    1716  1716.5
20   Y5    0     14      40      73      93      99    1057    2805    5068
21   $A    0   18.4    25.3
22   $E 1702   1712    1720
23   $$ 1712
24   $D 1715
25   K     1      3                                       1
26   M1                    ROUTING THRU REACH 2 - 3
27   Y                             1
28   Y1    1
29   Y6   .1    .09      .1    1673    1720    1100    .033
30   Y7    0    1700      10    1700     100    1680     140    1673     150    1673
31   Y7  170    1680     470    1700     860    1720
32   K             4                                       1
33   M1                    INFLOW HYDROGRAPH - BRADY LAKE SUBAREA
34   M     1      1    7.53           14.74
35   P           22.1     107     120     128     140
36   T                                                    1     .05
37   W  4.62     .45
38   X  -1.5    -.05       2
39   K     1      5                                       1
40   M1                    RESERVOIR ROUTING - THRU BRADY LAKE
41   Y                             1
42   Y1    1                                                1213     -1
43   Y4 1716   1717  1717.3  1717.7  1717.9  1718.3    1719    1720    1721    1724
44   Y5    0    127     196     337     431     652    1267    2736    4842    8224
45   $S    9     78     309     830    1253    2553    4741
46   $E 1699   1704    1709    1714    1716    1720    1724
47   $$ 1716
48   $D1717.7
49   K     1      6                                       1
50   M1                    ROUTING THRU REACH 5 - 6
51   Y                             1
52   Y1    1
53   Y6   .1    .08      .1    1701    1740    2500    .0043
54   Y7    0    1740      10    1740     700    1720     910    1701     970    1701
55   Y7 2820    1720    3900    1740    3910    1740
56   K     1      7                                       1
57   M1                    ROUTING THRU REACH 6 - 7
58   Y                             1
59   Y1    1
60   Y6   .1      .1      .1    1684    1720    2950    .0058
61   Y7    0    1720      10    1720     760    1700    1670    1684    1680    1684
62   Y7 7225    1700    3490    1720    1700    1720
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 62  Y7  2275    1700    3690    1720    3700    1720
 63  K      1       8                                       1
 64  K1                 ROUTING THRU REACH 7 - 8
 65  Y                                  1
 66  Y1     1
 67  Y6    .1     .09      .1    1663    1700    4650   .0045
 68  Y7     0    1700      10    1700     300    1680     480    1663     490    1663
 69  Y7   630    1680    1820    1700    1830    1700
 70  K              9                                       1
 71  K1                 INFLOW HYDROGRAPH - NORTH ARROWHEAD LAKE SUBAREA
 72  M      1       1     .89           14.74
 73  P             22.1     107     120     128     140
 74  T                                                   1     .05
 75  W   2.24     .45
 76  X   -1.5    -.05       2
 77  K      1      10                                       1
 78  K1                 RESERVOIR ROUTING - THRU NORTH ARROWHEAD LAKE
 79  Y                                  1
 80  Y1     1                                            413      -1
 81  Y41668.2    1669    1670    1671  1671.7  1672.5    1673    1674
 82  Y5     0     167     562    1091    1524    2119    2620    3980
 83  $A     0    82.6    96.4
 84  $E1653.2  1668.2    1680
 85  $$1668.2
 86  $D1671.7
 87  K             11                                       1
 88  K1                 INFLOW HYDROGRAPH - ARROWHEAD LAKE SUBAREA
 89  M      1       1     5.9           14.74
 90  P             22.1     107     120     128     140
 91  T                                                   1     .05
 92  W   4.43     .45
 93  X   -1.5    -.05       2
 94  K      4      12                                       1
 95  K1                 COMBINE HYDROGRAPHS AT ARROWHEAD LAKE
 96  K      1      13                                       1
 97  K1                 RESERVOIR ROUTING - THRU ARROWHEAD LAKE
 98  Y                                  1
 99  Y1     1                                           1077
100  $A     0   217.6   364.6   649.2
101  $E1637.2    1652    1660    1680
102  $$  1652     110    3.88     1.5
103  $D  1660     2.7     1.5     250
104  K     99
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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
RUNOFF HYDROGRAPH AT	4
ROUTE HYDROGRAPH TO	5
ROUTE HYDROGRAPH TO	6
ROUTE HYDROGRAPH TO	7
ROUTE HYDROGRAPH TO	8
RUNOFF HYDROGRAPH AT	9
ROUTE HYDROGRAPH TO	10
RUNOFF HYDROGRAPH AT	11
COMBINE 4 HYDROGRAPHS AT	12
ROUTE HYDROGRAPH TO	13
END OF NETWORK	

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	.42	1	982.	834.	687.	589.	491.	393.	294.	196.	98.
	(	1.09)	(	27.80)(	23.63)(	19.46)(	16.68)(	13.90)(	11.12)(	8.34)(	5.56)(	2.78
ROUTED TO	2	.42	1	976.	830.	683.	586.	488.	378.	246.	95.	54.
	(	1.09)	(	27.63)(	23.49)(	19.34)(	16.58)(	13.81)(	10.72)(	6.98)(	2.69)(	1.52
ROUTED TO	3	.42	1	977.	829.	678.	592.	510.	399.	259.	95.	54.
	(	1.09)	(	27.67)(	23.46)(	19.21)(	16.76)(	14.43)(	11.30)(	7.35)(	2.68)(	1.52
HYDROGRAPH AT	4	7.53	1	8511.	7234.	5956.	5107.	4256.	3404.	2553.	1702.	851.
	(	19.50)	(	241.01)(	204.86)(	168.71)(	144.60)(	120.50)(	96.40)(	72.30)(	48.20)(	24.10
ROUTED TO	5	7.53	1	6078.	5333.	4556.	3860.	3157.	2427.	1636.	880.	291.
	(	19.50)	(	172.11)(	151.02)(	129.02)(	109.31)(	89.41)(	68.73)(	46.33)(	24.93)(	8.23
ROUTED TO	6	7.53	1	6075.	5330.	4552.	3856.	3155.	2423.	1633.	879.	290.
	(	19.50)	(	172.02)(	150.94)(	128.90)(	109.20)(	89.33)(	68.61)(	46.24)(	24.90)(	8.21
ROUTED TO	7	7.53	1	6071.	5327.	4544.	3849.	3149.	2419.	1626.	877.	290.
	(	19.50)	(	171.90)(	150.84)(	128.67)(	109.00)(	89.16)(	68.47)(	46.04)(	24.83)(	8.21
ROUTED TO	8	7.53	1	6067.	5323.	4537.	3843.	3142.	2412.	1621.	874.	289.
	(	19.50.	(	171.79)(	150.74)(	128.47)(	108.81)(	88.99)(	68.31)(	45.89)(	24.76)(	8.18
HYDROGRAPH AT	9	.89	1	1630.	1386.	1141.	978.	815.	652.	489.	326.	163
	(	2.31)	(	46.16)(	39.24)(	32.31)(	27.70)(	23.08)(	18.47)(	13.85)(	9.23)(	4.62
ROUTED TO	10	.89	1	1310.	1099.	884.	745.	599.	467.	339.	206.	96
	(	2.31)	(	37.09)(	30.81)(	25.02)(	21.08)(	16.96)(	13.22)(	9.61)(	5.84)(	2.72
HYDROGRAPH AT	11	5.90	1	6871.	5841.	4810.	4123.	3436.	2749.	2061.	1374.	687.
	(	15.28)	(	194.58)(	165.39)(	136.20)(	116.75)(	97.29)(	77.83)(	58.37)(	38.92)(	19.46
4 COMBINED	12	14.74	1	13133.	11234.	9150.	7709.	6265.	4755.	3183.	1826.	893
	(	38.18)	(	371.88)(	318.11)(	259.09)(	218.29)(	177.41)(	134.64)(	90.13)(	51.70)(	25.27
ROUTED TO	13	14.74	1	11745.	9840.	8072.	6895.	5530.	4226.	2894.	1666.	669.
	(	38.18)	(	332.59)(	278.63)(	228.57)(	192.69)(	156.60)(	119.65)(	81.96)(	47.18)(	18.96

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1711.99	1712.00	1715.00
STORAGE	61.	61.	120.
OUTFLOW	0.	0.	99.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1715.46	.46	130.	976.	9.25	41.25	0.00
.85	1715.38	.38	128.	839.	8.50	41.25	0.00
.70	1715.30	.30	127.	683.	7.50	41.25	0.00
.60	1715.25	.25	126.	586.	6.50	41.25	0.00
.50	1715.20	.20	124.	488.	5.75	41.25	0.00
.40	1715.15	.15	123.	378.	4.75	41.50	0.00
.30	1715.08	.08	122.	246.	3.00	42.50	0.00
.20	1714.29	0.00	106.	95.	0.00	44.00	0.00
.10	1713.21	0.00	84.	54.	0.00	43.75	0.00

FLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	977.	1678.0	41.25
.85	829.	1677.6	41.25
.70	678.	1677.1	41.50
.60	592.	1676.8	41.25
.50	510.	1676.5	41.25
.40	399.	1676.1	41.75
.30	259.	1675.6	42.75
.20	95.	1674.1	44.00
.10	54.	1673.6	43.75

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SUMMARY OF DAM SAFETY ANALYSIS

FLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1716.00	1716.00	1717.70
STORAGE	1213.	1213.	1782.
OUTFLOW	0.	0.	337.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1722.10	4.40	3700.	6978.	35.25	47.75	0.00
.85	1721.44	3.74	3338.	5333.	33.75	47.50	0.00
.70	1720.86	3.16	3026.	4556.	32.00	47.25	0.00
.60	1720.53	2.83	2845.	3860.	30.75	47.25	0.00
.50	1720.20	2.50	2662.	3157.	29.25	47.25	0.00
.40	1719.79	2.09	2483.	2427.	27.50	47.75	0.00
.30	1719.25	1.55	2302.	1636.	25.00	48.50	0.00
.20	1718.56	.86	2071.	860.	20.50	50.25	0.00
.10	1717.57	0.00	1738.	291.	0.00	53.25	0.00

FLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6075.	1706.9	48.00
.85	5330.	1706.5	47.75
.70	4552.	1706.1	47.25

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6075.	1706.9	48.00
.85	5330.	1706.5	47.75
.70	4552.	1706.1	47.25
.60	3856.	1705.8	47.50
.50	3155.	1705.4	47.50
.40	2423.	1705.1	48.00
.30	1633.	1704.2	48.75
.20	879.	1703.5	50.50
.10	290.	1702.2	53.75

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6071.	1690.1	43.25
.85	5327.	1689.9	49.00
.70	4544.	1689.5	47.75
.60	3849.	1689.1	47.75
.50	3149.	1688.7	48.00
.40	2418.	1688.3	49.25
.30	1626.	1687.6	49.25
.20	877.	1686.7	51.00
.10	290.	1685.9	54.25

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6067.	1675.4	48.50
.85	5323.	1674.8	48.25
.70	4537.	1674.0	48.00
.60	3843.	1673.3	48.00
.50	3142.	1672.6	48.25
.40	2412.	1671.6	48.75
.30	1621.	1670.3	49.75
.20	874.	1668.7	51.50
.10	289.	1666.5	55.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1668.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.99	0.00	648.	1088.	0.00	43.75	0.00
.70	1670.61	0.00	615.	884.	0.00	44.00	0.00

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1666.20	1668.20	1671.70
STORAGE	413.	413.	709.
OUTFLOW	0.	0.	1524.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1671.35	0.00	679.	1310.	0.00	43.75	0.00
.85	1670.99	0.00	648.	1088.	0.00	43.75	0.00
.70	1670.61	0.00	615.	884.	0.00	44.00	0.00
.60	1670.35	0.00	593.	745.	0.00	44.00	0.00
.50	1670.07	0.00	569.	597.	0.00	44.00	0.00
.40	1669.76	0.00	543.	457.	0.00	44.25	0.00
.30	1669.44	0.00	516.	339.	0.00	44.25	0.00
.20	1669.10	0.00	488.	206.	0.00	44.75	0.00
.10	1668.66	0.00	451.	76.	0.00	45.00	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

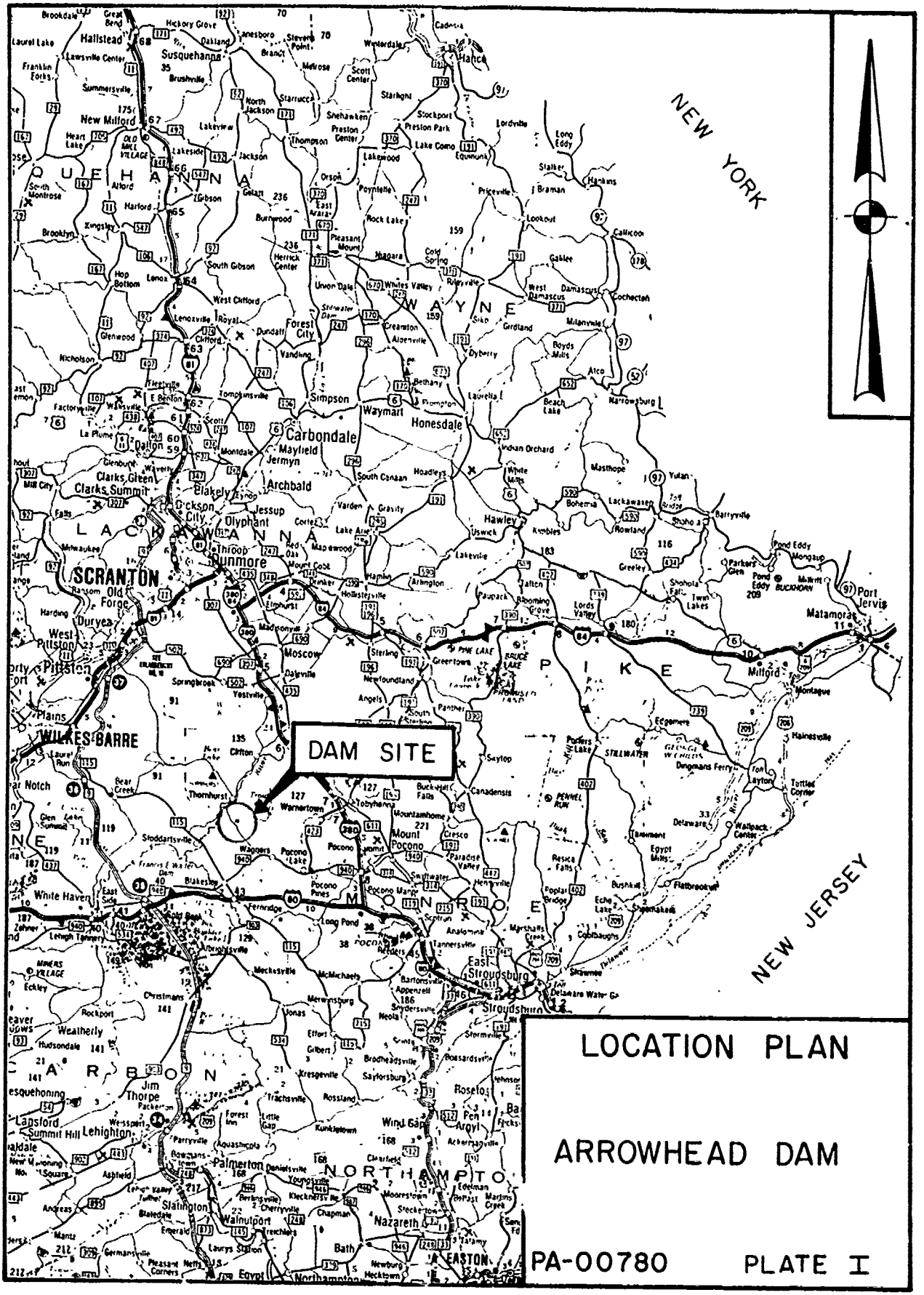
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1652.01	1652.00	1660.00
STORAGE	1076.	1073.	3377.
OUTFLOW	1.	0.	9657.

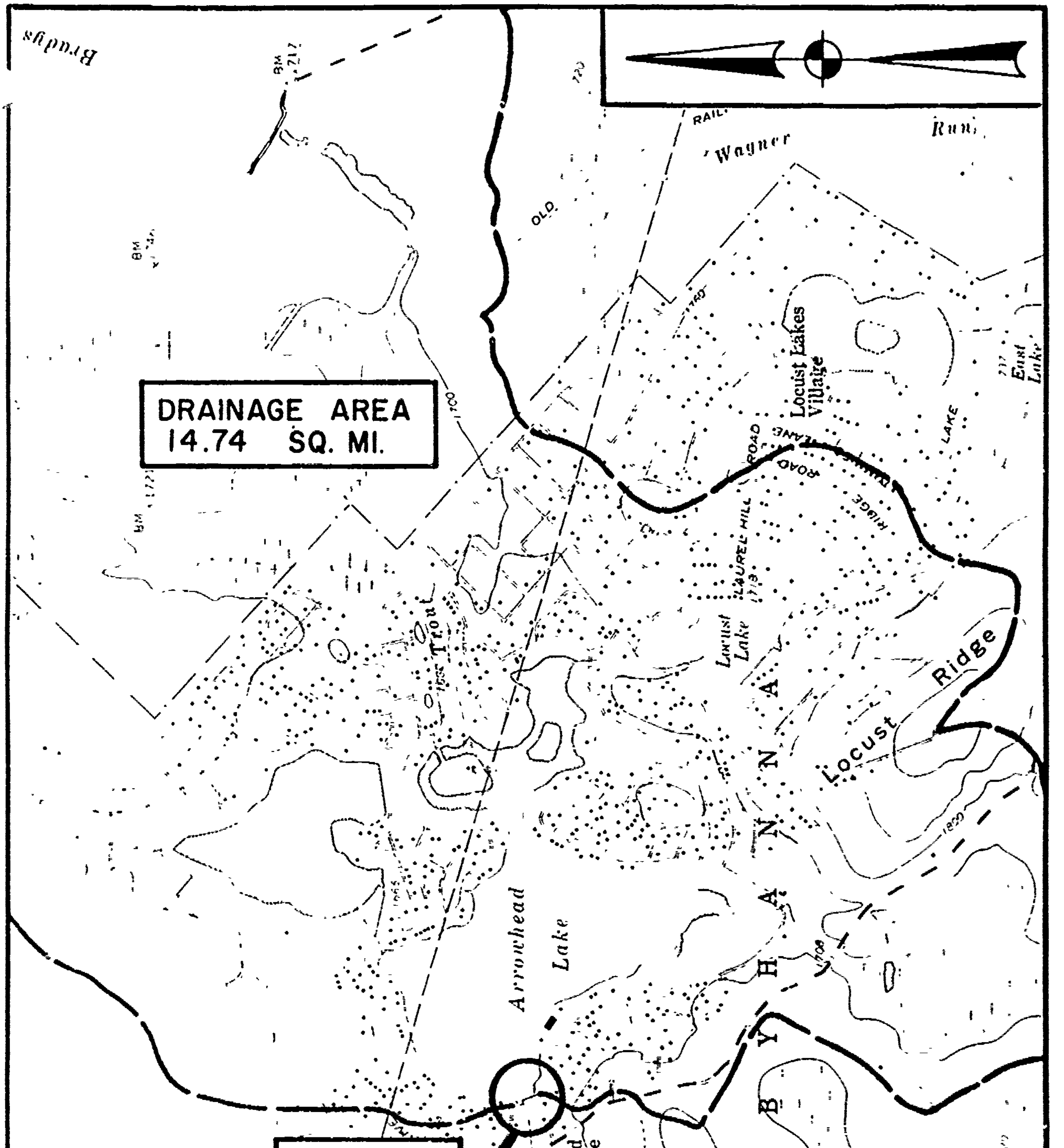
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1660.84	.84	3695.	11745.	7.25	47.50	0.00
.85	1660.09	.09	3410.	9840.	2.25	48.00	0.00
.70	1659.10	0.00	3057.	8072.	0.00	48.50	0.00
.60	1658.33	0.00	2798.	6805.	0.00	48.75	0.00
.50	1657.52	0.00	2534.	5530.	0.00	49.00	0.00
.40	1656.61	0.00	2257.	4226.	0.00	49.50	0.00
.30	1655.59	0.00	1960.	2894.	0.00	50.00	0.00
.20	1654.48	0.00	1664.	1666.	0.00	50.75	0.00
.10	1653.35	0.00	1382.	669.	0.00	49.75	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****
EOI ENCOUNTERED.
N>

APPENDIX E

PLATES


DAM SITE
NEW YORK
NEW JERSEY
SCRANTON
WILKES-BARRE
LACKAWANNA
WAYNE
PIKE
MONROE
CARBON
NORTHAMPTON
LOCATION PLAN
ARROWHEAD DAM
PA-00780
PLATE I



VICINITY MAP

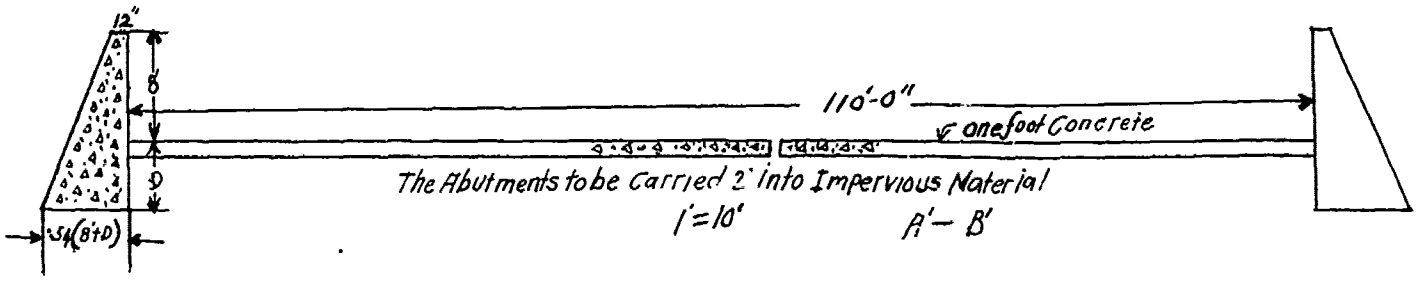
U.S.G.S. QUADRANGLE

THORNHURST, PA

ARROWHEAD DAM

SCALE: 1" = 2,000'

PA-00780 PLATE II

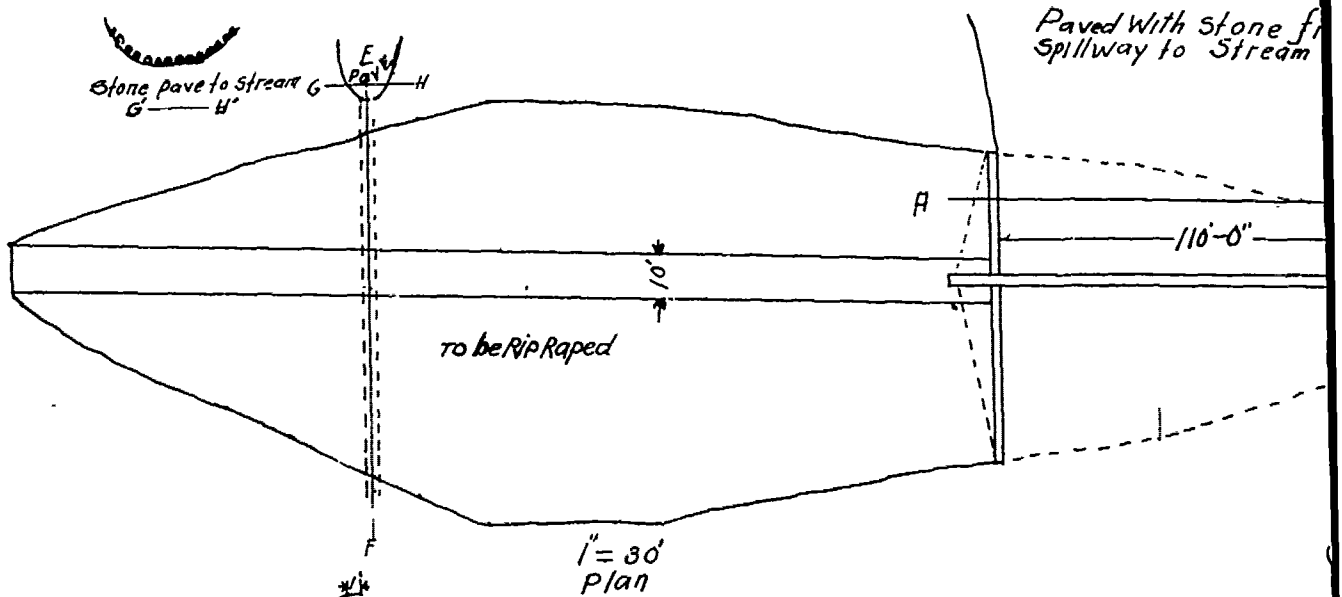


The Abutments to be Carried 2' into Impervious Material

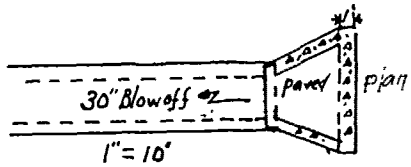
1'=10' A'– B'

Paved With Stone fr
Spillway to Stream

Stone pave to Stream G'—H'

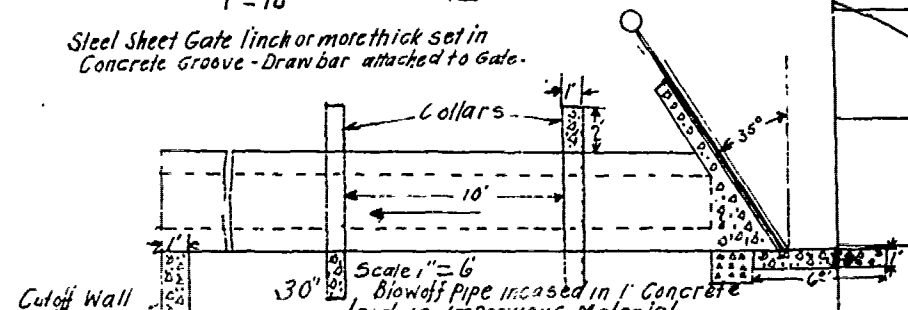


1"=30'
Plan



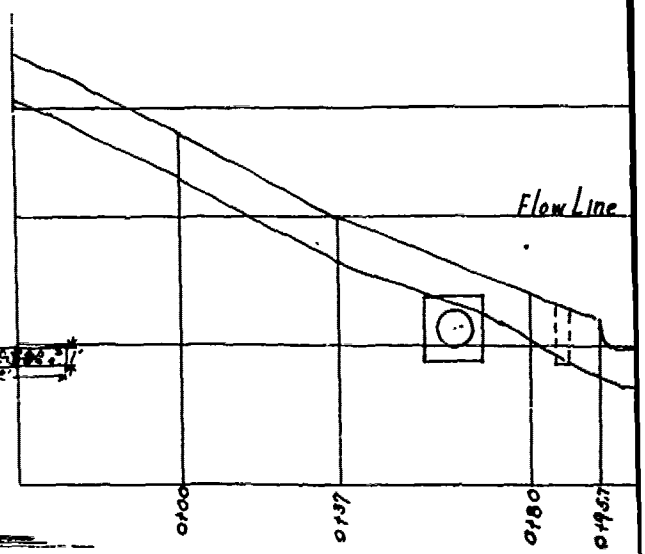
1"=10'

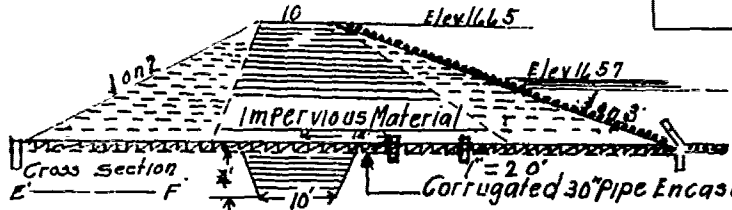
Steel Sheet Gate 1 inch or more thick set in Concrete Groove - Draw bar attached to Gate.



Scale 1"=6'

Blowoff Pipe incased in 1' Concrete laid in Impervious Material



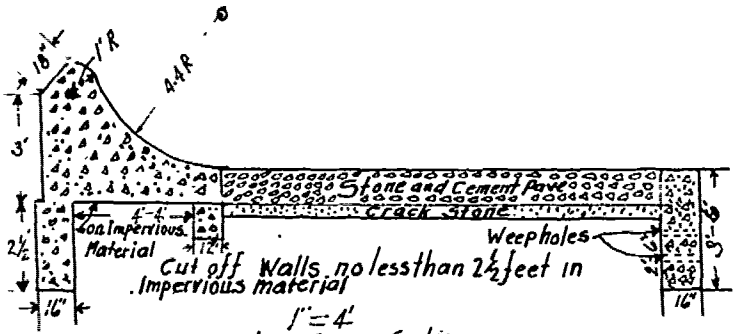


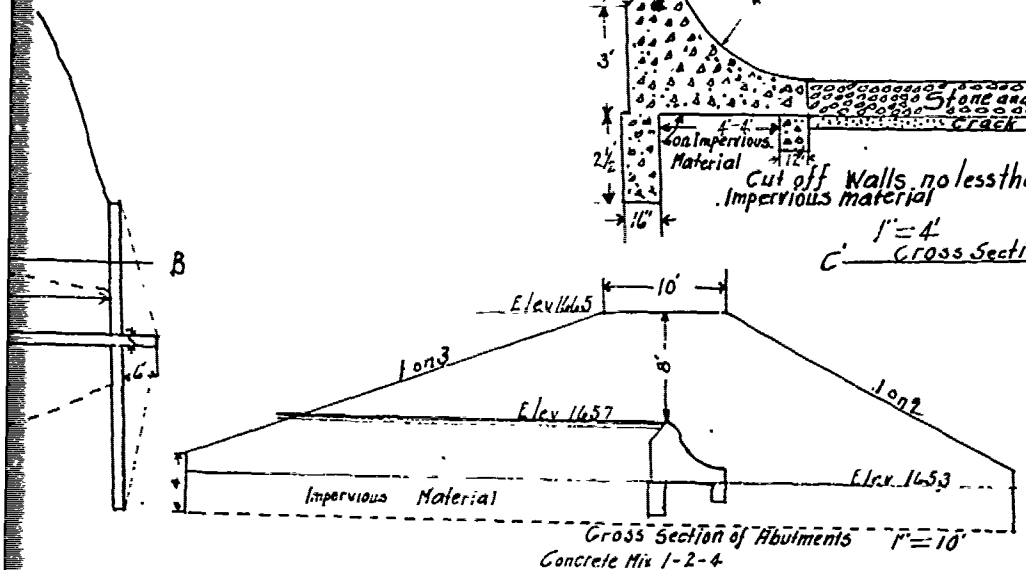
1"=20'

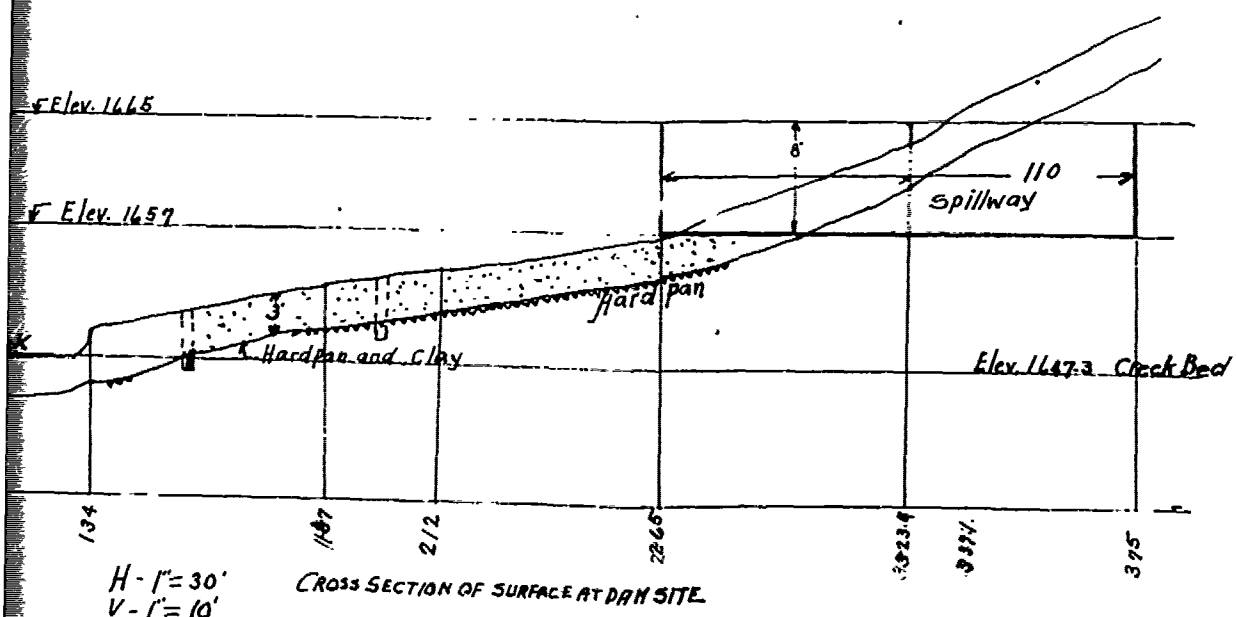
Corrugated 30" Pipe Encased by 1' Conc. With Conc. Collars

Impervious Material Placed in Layers of six inches Compaced With Sheep Foot Roller not Less than 300# per □"
The upstream area to be occupied by the embankment, Shall be Stripped to impervious earth
The downstream side shall be stripped of Sod and other undesirable materials

Area of proposed lake 230







H - 1"=30'
V - 1"=10'

CROSS SECTION OF SURFACE AT DAM SITE.

ROBBINS DOOR & SASH CO.

PROPOSED DAM FOR ~~MR. W. S. ROBBINS~~ 301 GREEN RIDGE ST. SCRANTON PA.

SITE LOCATED ON TROUT STREAM MONROE CO. PA.

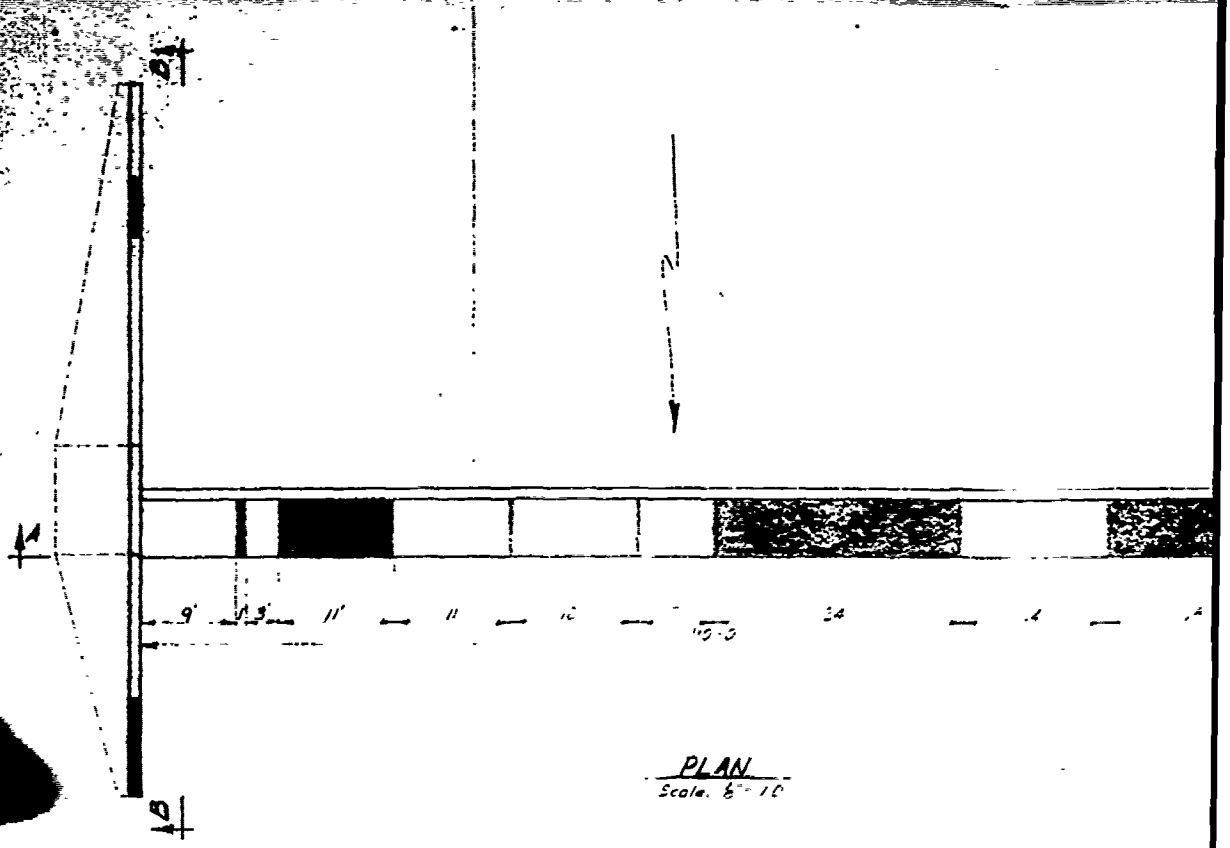
5 - 350,658,000 Gals. Approx.

2

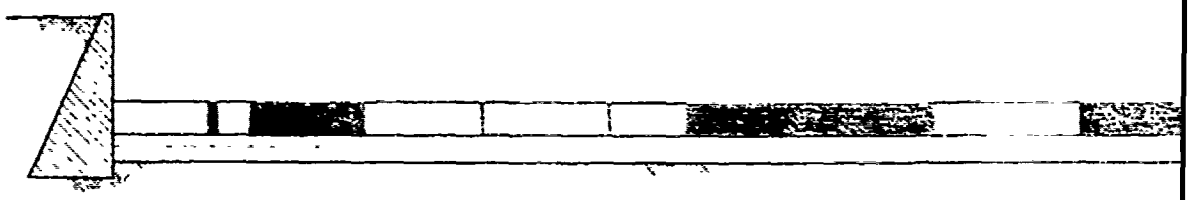
C. E. Ferris C.E.

PA-00780

PLATE III

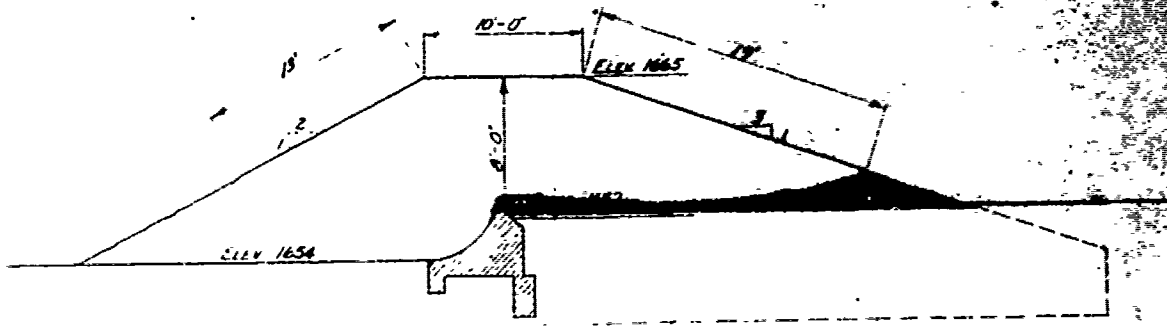


PLAN
Scale, 1/8" = 1'-0"

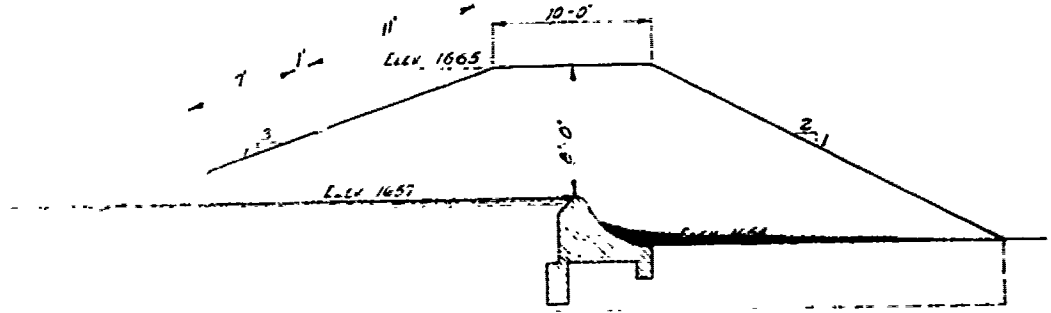


ELEVATION - SECTION A-A
Scale, 1/8" = 1'-0"

Drawn: RDE
Checked



ELEVATION - SECTION B-B
Scale 3/4" = 1'-0"



ELEVATION - SECTION C-C
3/4" = 1'-0"

GENERAL NOTES

- Shaded portions indicate deteriorated areas of concrete to be cleaned by chipping and/or sandblasting and repaired by the gunite method.
- Approximate surface area to be repaired equals 730 square feet.
- Dimensions and details of structure are from drawings originally prepared by C.E. Ferris, C.E. and presumed to be on file with the Pennsylvania Dept. of Forests and Waters.

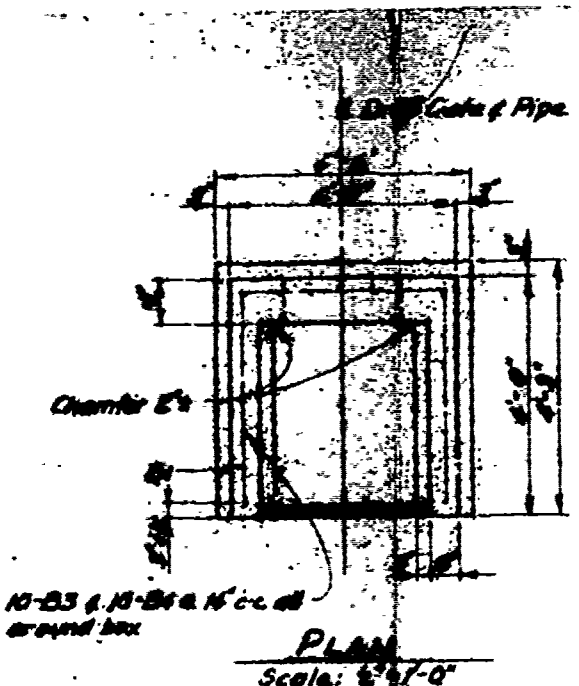
PRELIMINARY PRINT
SUBJECT TO CHANGE

PROPOSED

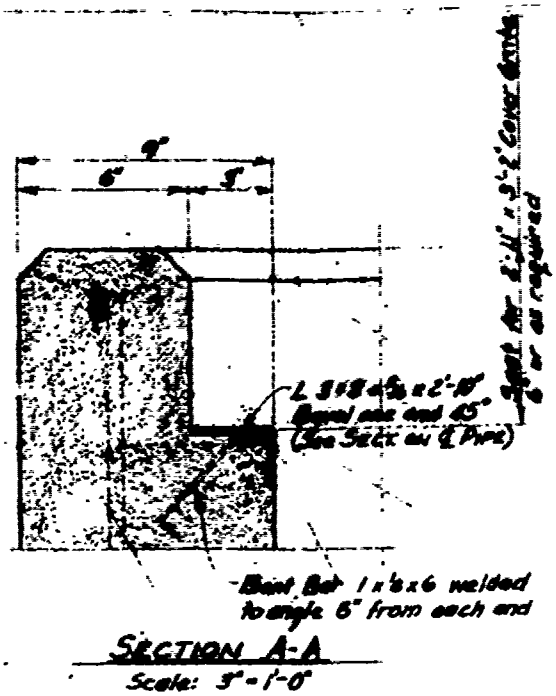
AUGUST, 1965
SCALE AS NOTED
SHEET 1 OF 1

MORRIS ENGINEERING, INC
STROUDSBURG, PENNA.
FILE NO E-65044

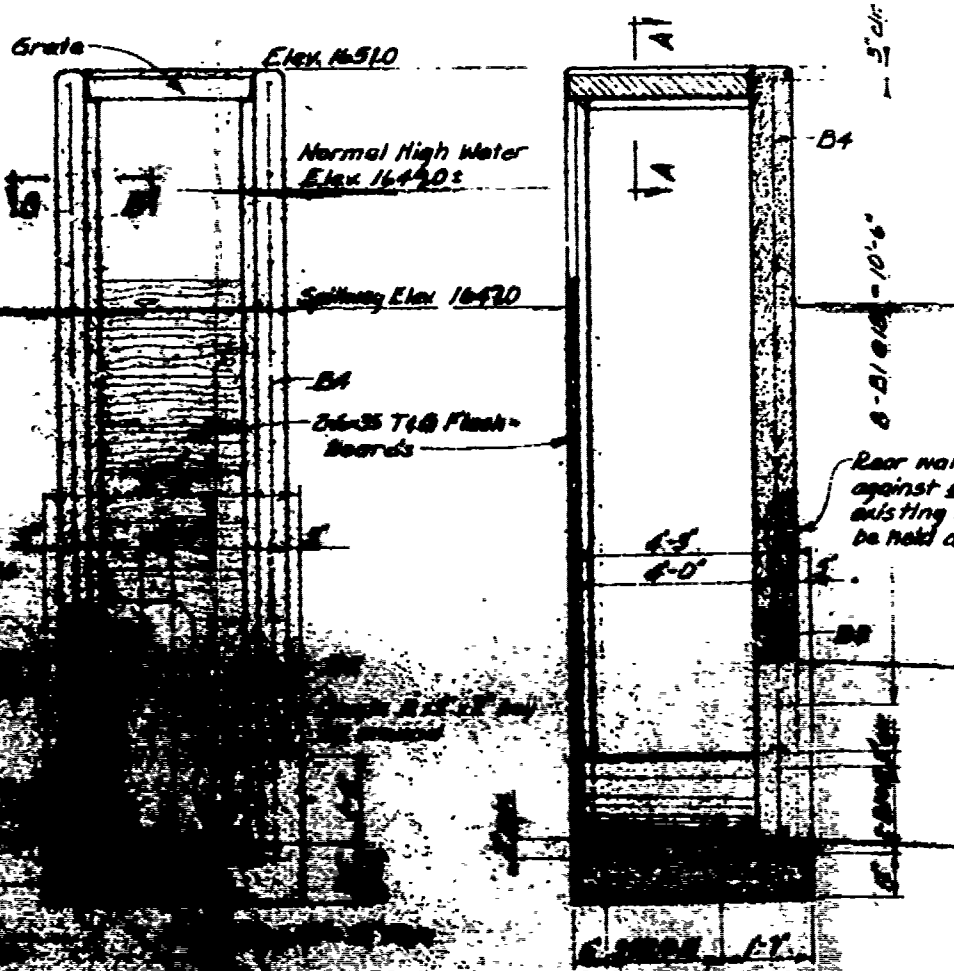
PA-0
PLAT



PLAN
Scale: 3/4"=1'-0"

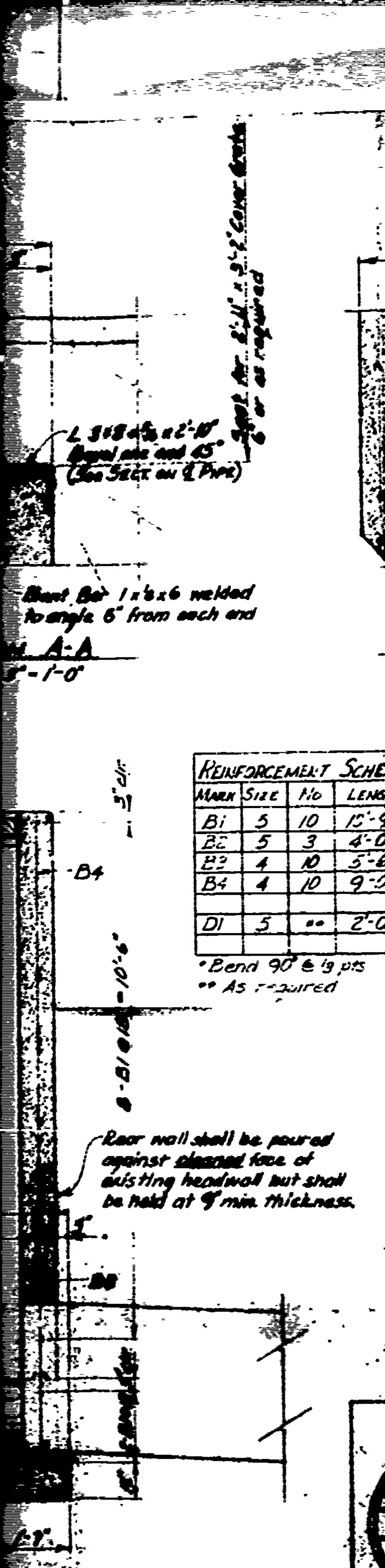


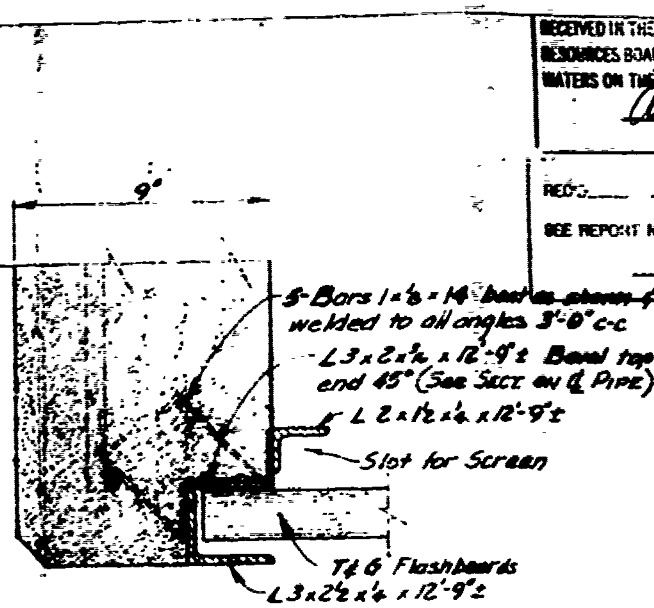
SECTION A-A
Scale: 3"=1'-0"



REINFORCEMENT SCHEDULE				
MARK	SIZE	No.	LENGTH	T
B1	5	10	10'-9"	B
B2	5	3	4'-0"	S
B3	4	10	5'-6"	S
B4	4	10	9'-9"	S
D1	5	**	2'-0"	S

* Bend 90° @ 9 pts.
** As required





SECTION B-B
Scale: 3" = 1'-0"

REINFORCEMENT SCHEDULE				
MARK	SIZE	NO	LENGTH	TYPE
B1	5	10	15'-9"	Bent*
B2	5	3	4'-0"	Str.
B3	4	10	5'-6"	Str.
B4	4	10	9'-0"	Str.
D1	5	**	2'-0"	Str.

*Bend 90° @ ¼ pts
** As required

GENERAL NOTES

- All concrete shall be Class A, 3000 psi [illegible] pressure strength at 28 days.
- Re[illegible] designed [illegible] grade [illegible]
- Chamfer [illegible] concrete edges [illegible]
- All [illegible] flashboards and steel [illegible]
- Where new concrete [illegible] 1/2 ϕ [illegible] 18" centers, or a minimum of 4 [illegible]
- Bent bars welded to angles for anchorage [illegible] minimum of 6" from the ends of the angles.
- Lumber [illegible] to be of [illegible] 1930 [illegible] established by the [illegible] Lumber Association.
- Cover Grate [illegible] a design [illegible] and shall be [illegible] that it could not be removed [illegible] unauthorized persons.
- Slope invert of footing block to match slope of [illegible] pipe.

PRELIMINARY PRINT
SUBJECT TO CHANGE

ARROWHEAD LAKE
Tobyhanna Township, Monroe County, Penna
ALL AMERICAN REALTY COMPANY

PROPOSED DROP GATE FOR DAM OUTLET CONDUIT

COMMONWEALTH OF PENNSYLVANIA – JOHN B. AICHER – PROFESSIONAL ENGINEER
John B. Aicher

October, 1965
Scale: As Noted
Sheet 1 of 1

Monroe Engineering, Inc.
Stroudsburg, Penna.
FILE No. E-65048

PA-0078
PLATE V

APPENDIX F

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Duncannon Member of the Catskill Formation.

Lithology: Fine to coarse grained grayish red sandstone interbedded with red siltstone and graying red shale. Beds arranged in fining - upward sequences with some conglomerate at the base of the cycle.

Structure

The dam is located in the Pocono Plateau area and the beds are nearly flat lying.

Air photo fracture traces trend: N5°E, N-S, and N85°E.

Overburden

The site is within the limits of Pleistocene glaciation and variable thicknesses of glacial till and outwash sediments are present in the area. Plans for the dam indicate that test pits showed three feet of soil over "hardpan and clay." This last apparently refers to till.

Aquifer Characteristics

The rocks of the Catskill Formation are essentially impermeable and ground water movement is entirely along bedding planes and fractures. The most permeable aquifers in the area are the sands and gravel of the glacial outwash commonly found in the valleys.

Discussion

The plans indicate that a cutoff trench was to be dug four feet deep - that would be just barely into the clay foundation. Some leakage through the overburden, or along the N85°E fracture trace in the bedrock, appears possible.

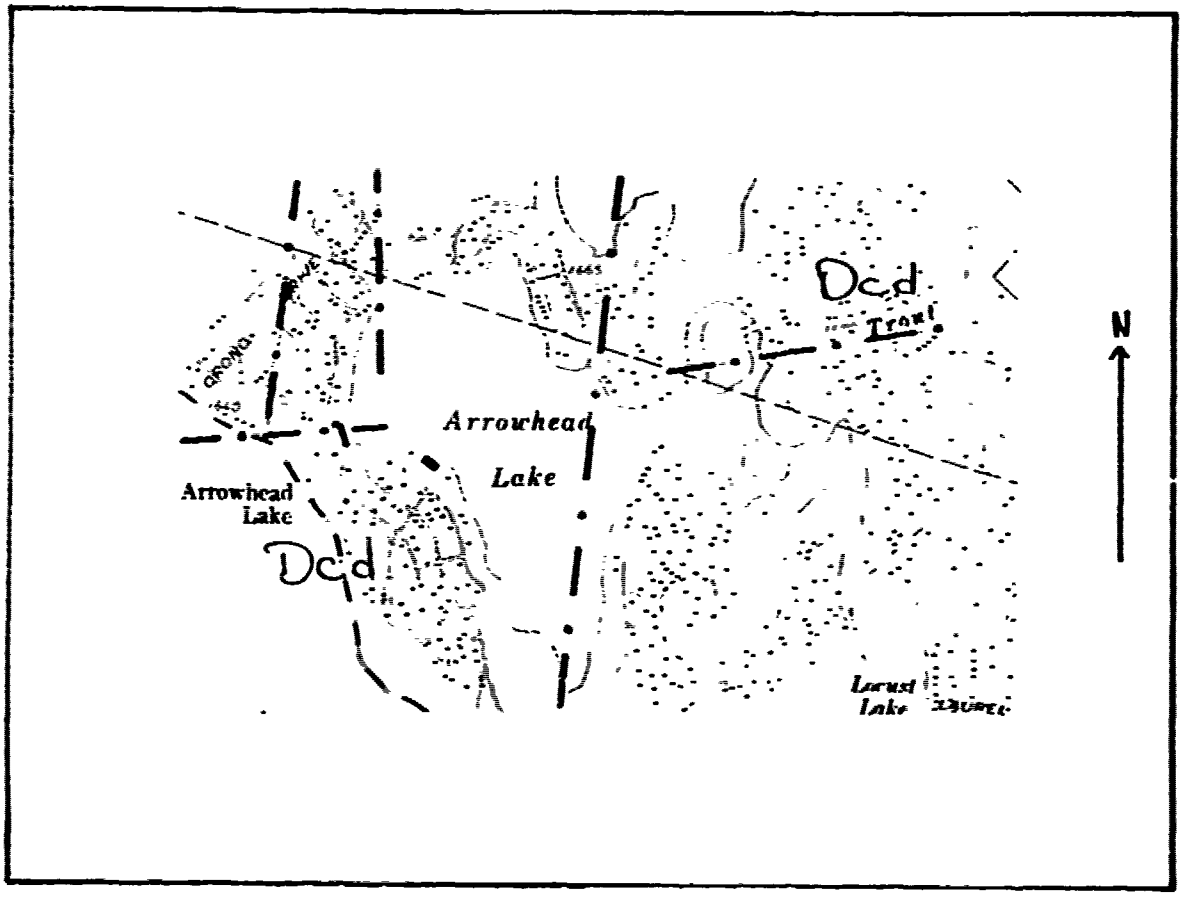
Sources of Information

1. W.D. Sevon (1975), "Geology of the Tobyhanna and Buck Hill Falls Quadrangle," Pa. Geological Survey Bulletin A204ab.

2. Air Photographs, dated 1973. Scale 1:40,000.

3. Plans and reports in file.

GEOLOGIC MAP – Arrowhead Lake Dam



Dcd — Catskill Fm.– Duncannon member

— · — · — air photo fracture trace

SCALE 1:24000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

CONTOUR INTERVAL 20 FEET